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Engineering News-Record

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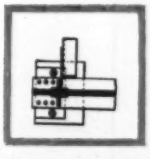
PLATE GIRDER DESIGN has been the subject of numerous books but there are many points of practical detail which they overlook.



ROBINS FLEMING, of the American Bridge Co., has drawn on his long experience as a structural designer for the article in this issue that supplements the texts on plate girders.

TWENTY PRACTICAL HINTS to detailers of plate girders accompanies the valuable observations on plate design, rivet pitch, stiffener layout and economic sizes.

Other articles in this issue:

Federal Valuation of Railroads and Its Results

Taxing Gasoline for Highway Improvements

Second Water Purification Plant for Dallas, Texas

Half Dozen Pages of Job and Office Kinks

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Off Into the Mud

"OFF into the mud" was a common phrase of motorists five years ago and expressed their disapproval when at the end of paved city streets they dropped into the mud of unimproved rural highways. The expression is still appropriate, but now, in most of the Northeastern states at least, has a different application. The mud now is not so much on the rural highways as it is on the streets of our villages and smaller cities. If it is not mud that greets the motorist, it is rough, poorly maintained pavements. Today, the rural highways are taking the lead in evenness and comfort and the small towns furnish the contrast by which the state highways are the better appreciated. It is time that the small cities brought their streets to the standards of the state highway systems.

Engineers in Interstate Commerce

NEW YORK'S engineer licensing act has been amended so as to exempt the "practice of professional engineering or land surveying, solely as an officer or an employer of a corporation engaged in interstate commerce." The amendment went through in the last hours of the legislature and was little discussed so that its intent is not clear but the general understanding is that it was intended to apply to railroad engineers. Some engineers in the state, however, are now raising the question of the class covered by the new clause and are suggesting the possibility of its extending to those in the employ of any manufacturing company shipping goods or doing business outside the state. By judicial interpretation interstate commerce has come to mean the transmission of goods and of intelligence between the states. Power transmission is not so clearly established as a part of interstate commerce but it probably will become so in time. There should be no doubt, then, that in New York the engineers of the railroad, power, telephone and telegraph companies operating beyond the state need not be licensed for the work of their own companies. How far beyond these classes the exemption extends remains for the licensing commission to rule and perhaps, later, for the courts to decide. The Sherman Act is based on the application of the interstate commerce clause of the Constitution to general interstate business; possibly the same interpretation will apply to licensing engineers. If it does the New York licensing law becomes ridiculous in its limited control of engineering practice.

National Inter-relations

SLOWLY but none the less surely the Ruhr situation, with its collateral question of reparations, is reaching a solution. Nations move deliberately toward the settlement of their difficulties and they move with due recognition of the many steps each must take before reaching the common ground. France is beginning to appreciate how difficult it is to collect money with soldiers; Germany knows now how it feels to quarter foreign troops, even in times of peace. Each is prepared to give way somewhat from their pre-occupation period stand and the world can do little but wait until each is satisfied the other will go no further. While it is waiting though it can pray for an early solution because national business cannot become settled until so important an international question is settled. This inter-relation of the business of the world may not always be realized by those whose own business does not go beyond their own borders but it exists nevertheless. In a recent address George M. Roberts, of the National City Bank, points out an instance that exemplifies this excellently. "India and Russia," he said, "never had much direct trade with each other. But one of the principal products of India is tea, and Russia before the war was a great tea consuming country. India sold tea to England and took her pay for it in cotton goods, made in Lancashire. England sold tea to Russia and took her pay in Russian products. The inability of Russia to buy tea affected the ability of India to buy cotton goods with the result that in 1921 Lancashire had the worst year in the cotton goods trade since the American civil war. And the inability of Lancashire to sell cotton goods caused her to cut down her purchases of raw cotton in the United States, with the result that cotton fell from 43 cents a pound in 1920 to 11 cents in 1921, and this loss of purchasing power to the southern farmers affected all the industries of this country."

Constructive Criticism Needed

CONSTRUCTIVE criticism of the Ripley plan of railroad consolidation did not mark the Interstate Commerce Commission's hearings either at St. Louis or Washington. There has been, on the contrary, a great deal of selfish expression and many unsound arguments. Cities complain of prospective loss of the main offices of one or more railways; state public service commissions see certain traffic leaving their states because under consolidation some commodities may be moved by the more direct and economical routes made possible by the consolidation; railroad presidents, blinded by their resentment of the whole plan of government regulation, attempt to obstruct the proceedings by wordy discussions of irrelevant subjects; all lack the vision to see that any move that is sound economically will, in the end, benefit them by benefiting the country as a whole. They fail to appreciate that any temporary loss which they may suffer will be completely recovered in increased traffic that will naturally come with the growth of the country and which will be stimulated by a rejuvenation of our railroad systems, which may possibly come by consolidation. The Interstate Commerce Commission has ample power to see that needed lines will not be abandoned and that rates will not be raised when competition is eliminated. Elimination of duplicate facilities and staffs, and roundabout routing of

shipments should be of permanent advantage. These benefits are a part of the proposed plan, which is not perfect but which can be discussed in the mood of constructive criticism. There were men at the hearings who did this, but they are the exceptions — men like Rea, of the Pennsylvania; Smith, of the New York Central, and Colston, of the New York, Chicago & St. Louis. They have come forward with qualified approval of the plan of consolidation and have explained their qualifications clearly. It is to be hoped that as the hearings proceed there will be more witnesses like them. Only thus can we hope for real progress.

Watershed Contamination

THAT utter disregard for watershed sanitation exists in many foreign countries is not realized by most of us. Serious direct contamination of water supplies in North America is a thing of the past except for an occasional example of accident or neglect, and that chiefly in the smaller cities and towns. But in some of the less highly developed countries to the south of us a sense of water-supply protection does not always go hand in hand with the development of that supply. A few weeks ago, for instance, an American engineer stated in these columns that not in his 17 years experience has he seen anything approaching the visible pollution that he noted on the watersheds of Bogota, a South American capital of nearly half a million people. So gross was it that he had his doubts of the efficacy of chlorine alone during the rainy season. Travelers say that were it not for the almost continual cold climate, averaging and rarely exceeding 65 deg. F. in the high plateau on which the city is located, the typhoid and dysentery record of Bogota would be far worse than it is. Happily, the Bogotanos are learning of sanitation, for negotiations with American engineers and contractors have been under way for more than a year which, if consummated, will give the city filters and other modern water-supply equipment. Thus instruction in the technic of engineering goes along with the introduction of engineering machinery and equipment.

Against Price Exchanges

TRADE associations for the exchange solely and privately to the trade of information as to sales and prices are definitely proscribed by the decision of the Supreme Court in the linseed oil case, noted in the news pages. Although the court in so ruling reversed the lower courts its decision is in keeping with the recent trend of decisions in the open-price association cases. It is definitely established now that the exchange of price and stock information either by the ostensible competitors direct or through the medium of an independent agency is in violation of the Sherman Act. The legality of statistical interchange through the medium of a public or private body which will make the data available to both producer and consumer still remains to be seen, for the court specifically refused to rule on such a possibility. Collection and distribution of such information by such an open agent as the Department of Commerce would be a desirable step toward future predictions and the smoothing out of the curve of business, especially if some prediction of demand could also be made. Producers, however, seem to be somewhat fearful of this entry of government into business control, even in a purely statistical function, and the prospects of its immediate adoption are not especially bright.

Arbitration in Contract Practice

AFTER a year, differences have again arisen between the Commissioners of Sewers of Louisville and the contractors who have been building the commission sewers. Arbitrary action, exacting requirements, indecision and delay by the engineers of the commission, it is charged by the contractors, are causing extra expenses which are making work unprofitable at prices which, with reasonable engineering direction, would return a fair profit. Certain contractors as a group have refused to undertake further work for the commission unless it shall write into its contracts a clause providing for arbitration of disputes. With the object of forcing the issue by an appeal to the public, advertisements are being published in the local newspapers.

Criticism of the Louisville sewer contracts is not new. A year ago when the commission-contracts for construction now in progress were first presented, protest was made by local contractors against their drastic powers and the inclusion of an arbitration clause was urged. The situation which developed was discussed editorially in *Engineering News-Record*, Aug. 17, 1922, p. 258. As then stated the request of the contractors for an arbitration clause was refused. The most in this respect that the commissioners would concede was the privilege of appealing from the decision of their engineers to the commissioners themselves. Construction was undertaken with this understanding. Apparently this arrangement has failed to meet the situation. Certainly the contractors who have been working under it for a year are not satisfied. They are again demanding that the written contracts shall provide for arbitration, not by the commission of disputes in which its own engineer is accused, but by an independent body of arbitrators.

As a dispute over the right of specific claims, the Louisville case has no greater significance than a score of others which any contractor or engineer long in practice can recall. It is important solely because arbitration as a provision of engineering contracts is put in question, and because there has come about in a year a pronounced change in the attitude of engineers toward such formal provision for arbitration. This new feeling is largely the result of the work of the Joint Conference on Uniform Contracts. In many meetings the committee of the nine technical societies participating in this conference has laid down a principle of arbitration in engineering contracts:

"The architect (or engineer) shall, within a reasonable time, make decision on all claims of the owner or contractor and on all other matters relating to the execution and progress of the work or interpretation of the contract document. All such decisions of the architect (or engineer) shall be final except as to the element of time and the financial considerations involved, which if no agreement in regard thereto is reached, shall be subject to arbitration."

There is evident in this statement of principle a conscientious effort to safeguard the prerogatives of the engineer in technical matters, progress of work and the results to be obtained which he must maintain if he is to assume responsibility and fear of losing which has been always his main reason for withholding specific provision for arbitration from his written contracts. Limited as it is to the determination of facts in questions of time and compensation, there is nothing in this

statement of principle to which fair-minded engineers will object and much less is there anything which need arouse their fear.

Few engineers who have not followed the progress of arbitration in detail realize, besides the advance made by the Joint Conference work, how far ahead it has gone as a recognized principle of contract practice. It is one of the requirements which the Interdepartmental Board of Contracts and Adjustments now engaged in standardizing and harmonizing federal government contracts has laid down as essential. The American Institute of Architects has already a clause substantially the same. Besides the architects two other participants in the Joint Conference have approved the principle laid down by the committee. Limited arbitration has been indorsed by the Association of State Highway Officials.

There is ample precedent in support of the contention of the sewer contractors of Louisville that an arbitration clause is a desirable addition to the contracts under which they are working. Their procedure in advancing their case is not so well supported. They also have to guard against expecting too much from the privilege of arbitration. There are differences in contractual relations which are arbitrable but they do not include any which prejudice the authority of the engineer over the execution and progress of the work for which he in the last analysis is solely responsible.

Mandatory Engineering

BLANKET legislation with specific intent is always vicious; no better illustration can be found than the Strauss-Kaufman railway electrification bill recently approved by Governor Smith of New York. That bill in effect calls for the electrification before 1926 of all railroads within the corporate boundaries of New York City. It admittedly was designed to put an end to the operation of steam locomotives close to certain high-class residential districts in New York, more especially along Riverside Drive. To gain this end it orders the electrification of some 311 miles of railroad, most of it now on grade with grade crossings, and some of it in remote parts of the city of New York, which has within its limits districts as rural as though they were a hundred miles away from any city much less the largest one on the continent.

Railroad conditions along the west shore of Manhattan Island have long been a disgrace, but the smoke nuisance, the cause of this present action, is not the greatest of them. The whole layout with its numerous grade crossings and tracks which require operation of trains through busy streets is fundamentally wrong. It should have been done away with years ago, as it would have been if the railroad plan submitted in 1911 had been received in the proper spirit and the present administration of New York City had not played politics with the whole situation. If the proposed bill had no effect whatever on the intolerable track condition, it would not be so bad, but unfortunately it has a very serious bearing on it—it will complicate it greatly. To comply with the law the New York Central R.R. must electrify all of its tracks, most of them at street level from Spuyten Duyvil Creek to Canal St., in a time which does not permit of the radical revision of track layout and elevation that is required for a rational solution of the West Side problem. Its only recourse, then, would be to resort to an overhead trolley system with a multitude of poles and vast network of wires stretched down along the side of Manhattan Island, all of which will require an expenditure that will go for nothing in a few years when public opinion forces the removal of the grade operation, as it surely will.

The general ordering of electrification all over the city is no less ridiculous. It is not possible merely to string electric wires along a railroad to have proper electrification. Revision of grade and line go along with the change of motive power. The complete revision necessary for proper electrification is not necessarily demanded everywhere in New York City, any more than it is demanded on all the railroads of the country.

The only justification of this bill may be that it will force some recognition of the necessity of adjusting the difficulties of the railroad and the city in the matter of the West Side problem so that the next legislature may be in a position to repeal the current act in favor of one which will serve as a more rational approach to the problem of proper railroad facilities inside the city of New York. The settling of engineering problems by blanket mandatory legislation will never satisfy anybody.

Why Not a "Sales Engineer"

WITH the intention of provoking thought and discussion rather than of making a dogmatic assertion we ventured editorially to suggest some months ago that the term "sales engineer" was a misnomer and that the engineering profession should discourage its use. The note did bring the desired discussion but it was mostly from men who wear the title "sales engineer" and who felt that their vocation had been unfairly attacked. For the most part they contended that they were both engineers and salesmen and that the very success of their salesmanship depended upon their engineering knowledge and experience. In other words they did not defend their title but their business.

To deny the desirability of engineering experience in certain kinds of selling was and is the farthest from our thoughts. Obviously those who sell an engineering product are best prepared when they know how that product is made and used and can talk the language of its users. The engineer engaged in the honorable and useful business of selling such a product does not lose his membership in the engineering profession. It is when he confuses what he is with what he does and applies to the generic term engineer the descriptive adjective sales that he offends the profession, because he thereby implies that there is a type of engineering essentially involved in the selling of goods. This is not a fact. The process of making a sale is not an engineering one. It is not subject to the same sort of scientific classification as engineering nor does it rest upon the same scientific principles. The word sales is not descriptive of engineering knowledge or practice. Engineers are needed to make certain kinds of sales but their engineering knowledge is applied to the process or material involved and not to the handling of the prospect or the getting of the signature, the technic of which is the essence of salesmanship.

An "engineer-salesman" or a "salesman-engineer" is a legitimate person; there is no such thing as a "sales engineer." This may seem a quibble but to our mind the distinction is vital and by analogy extends to the many other kinds of adjectival engineers whose multiplication can only weaken the engineering profession.

Plate-Girder Design and Detailing—Notes from Practice

Methods of Calculating the Resisting Moment—Strength of Wide Cover Plates—Stiffener Spacing and Rivet Pitch as Governed by Web Shear—Twenty Hints to the Detailer—Torsion in Box Girders

By Robins Fleming
Structural Engineer, American Bridge Co., New York City

PLATE-GIRDER design in practice involves a number of difficulties which are either neglected or not fully treated in the existing literature of the subject, extensive as it is. The following notes gathered from observation and experience may be of help in dealing with them. The notes are confined to parallel-flange simple girders, i.e., girders having flanges composed of a pair of angles with or without cover plates. Girders of other types present additional difficulties that cannot be discussed within the limits of the present article; moreover, simple flanges are to be preferred, where practicable.

Methods of Designing Plate Girders—Values for the resisting moments of various girders, according to five methods of calculation, are given in Table I. As the load that a girder can carry varies as its resisting moment, and as f is constant, the reader can easily make comparisons from the figures in parentheses.

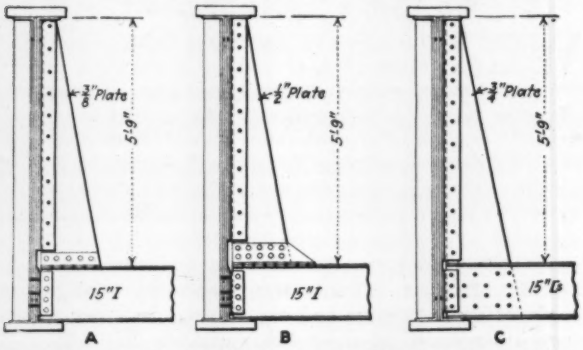


FIG. 1—WEAK KNEEBRACE CONNECTION AND TWO PREFERABLE DETAILS

There is little or no practical objection to using the moment of inertia of the gross section, M_1 in the table, even if it is not theoretically correct. As usually designed both flanges have the same section, and under ordinary conditions the ratio of the strengths of the flanges is such that the liability of failure of the top flange by buckling is greater than that of the bottom flange by rupture through the net section. This relative strength of the flanges, if of the same section, exists and is not altered by assumptions made in design.

The requirement in many specifications that the net section be used in determining the moment of inertia, M_3 in the table, seems needlessly severe.

Using the gross area of the top flange and the net area of the bottom flange, M_5, is nearer exact than any other method of the table. For flanges of the same section the neutral axis can quite accurately be assumed at the center of the girder section. The net section of the bottom flange exists only over a small proportion of its length, and it is not likely that the neutral axis of the girder will turn sharply up and down; it will probably remain very near the neutral axis of the preponderating section. However, even considering a section through rivet holes of the tension flange the location of the neutral axis is but slightly changed from the center line of the girder. For girder 1 of the table it is raised 0.4 in., changing the coefficient of M_1 from 193 to 185; for girder 4 it is raised 0.3 in., changing 406 to 391; for girder 14 it is raised 0.5 in., changing 1,745 to 1,651; and for girder 15 it is raised 0.67 in., changing 645 to 604.

Because of its simplicity, the writer prefers for ordinary girders the chord-stress method $M_4 = fd(A_f + \frac{1}{6} d_1 t)$. The limitations of this method should be well understood. Girders of unusual section, and shallow girders with several cover plates piled on the flange angles, should be proportioned by the moment-of-inertia method, as the chord-stress method may give too small flange areas. When designing plate girders in competition with rolled beams of the larger sizes it is often an advantage to use the moment-of-inertia method.

Some engineers in using the chord-stress method assume that the web resists no moment. The values of M_4 would thus be less than those shown in the table—about 13 per cent in girder 1, 12 per cent in girder 14, 6 per cent in girder 15.

For preliminary designs and estimates the equation $M_2 = fd_1A_f$ is especially convenient. It gives flange areas that are too large but not enough so to make it useless for approximate estimates.

Compression Flanges—The strength of plate girders with compression flanges unsupported laterally is an unsettled point. The formulas that have been presented for proportioning such flanges are many and varied. The writer has recommended (*Engineering News-Record*, Feb. 24, 1921, p. 336) the formula $S = 19{,}000 - 250\ l/b$ for plate girders without cover plates, and $S = 19{,}000 - 225\ l/b$ for plate girders with cover plates, in which S is the allowable stress, lb. per sq.in., with a maximum of 16,000; l is the unsupported length of flange, inches; and b is the width of flange, inches. If stiffeners are placed not farther apart than the depth of the girder, and their outstanding legs extend to the edge of the flange angles, these equations could safely be changed to $S = 19{,}000 - 225\ l/b$ and $S = 19{,}000 - 200\ l/b$.

A fault in many through plate-girder bridges with shallow floorbeams is the weakness of lateral support of the top flanges of the main girders. Fig. 1, sketch A shows a detail of a bridge on a leading railroad. (It is surprising that the detail "got by" the bridge engineer of this road.) If the detail of sketch B had been used the strength to resist lateral thrust at the top flange would be increased 50 per cent; with that of sketch C the strength would be three times as great.

Cover Plates—The maximum width of cover plates is fixed in most specifications by the requirement that the projection beyond the outer line of rivets shall not exceed 6 in. nor be greater than 8 times the thickness of the thinnest plate. What values shall be given to

plates where these limits are exceeded? The writer suggests the following paragraph for specifications:

Cover plates to have their full sectional area included in flange section shall not project beyond the outer line of rivets more than 6 in. or more than 8 times the thickness of the thinnest plate. Cover plates exceeding these limits not more than 50 per cent may have one-half the excess section included in flange section. No part of a projection beyond the outer line of rivets more than 9 in. or more than 12 times the thickness of the thinnest plate shall be considered as part of the flange section.

Web Plates—Notwithstanding the complicated nature of web stresses it has been found perfectly safe to design a web plate by making it thick enough to resist the maximum shearing stress assumed to be uniformly distributed over the cross-sectional area, and also thick enough to enable the flange-stress increments to be taken into the flanges by permissible rivet spacing. A limiting minimum thickness should be used, say $\frac{1}{4}$ in. for building, $\frac{5}{16}$ in. for highway and railway work of E40 or less loading, and $\frac{3}{8}$ in. for railway work of more than E40 loading.

Specifications differ as to whether the unit shearing stress for proportioning web plates should be applied to net section or to gross section. The specifications (1923) of the American Society of Civil Engineers call for 12,000 lb. per sq.in. on the net section, while the specifications of the American Railway Engineering Association (1906, 1910, 1920) call for 10,000 lb. per sq.in. on the gross section. All these specifications use 16,000 lb. per sq.in. for axial tension on net section. To equate the values of 10,000 gross and 12,000 net the net area of web must equal five-sixths of the gross area.

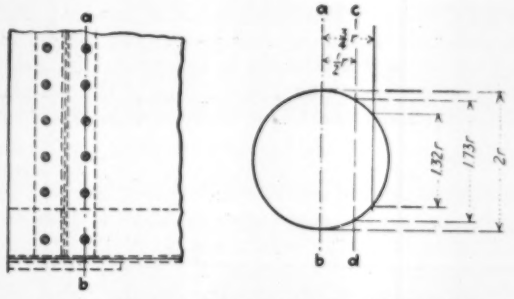


FIG. 2—SHEAR SECTION AT END STIFFENER

This is seldom the case through the vertical rows of rivets connecting end stiffeners. If $\frac{7}{8}$-in. rivets spaced 4 in. apart were used the ratio of net to gross would be $\frac{4}{5}$, equivalent to a value of 13,330 lb. per sq.in. on the net section for 10,000 on the gross section.

Theoretically, the gross section can safely be used. In Fig. 2 let *ab* be a partial section through the end stiffeners, where shear is greatest. The rivets relieve the shear in the web plate by an amount equal to one-half their bearing value, thus reducing the shear in the net section by this amount. (The section through rivet on line *c*—*d* is $\frac{1}{2}$ of 1.73 of that on line *a*—*b*, but the shear is reduced by only one-fourth the bearing value of the rivet.) It is well, however, to restrict the punching of the web, and as the designer does not always control details he may better use a larger unit stress and proportion the web for an equivalent net section. The writer would not hesitate to change the 10,000 lb. per sq.in. on net section of his specifications to three-

TABLE I—RESISTING MOMENTS OF PLATE GIRDERS

No.	Girder Section	Flange Area, Gross A_1	Flange Area, Net A_2	$M_1 = fS_1$ Gross Section	$M_2 = fS_2$ Net Section	$M_3 = fS_3$ Top Flange Gross / Bott. Flange Net	$M_4 = fd\left(A_2 + \frac{d_1 t}{8}\right)$	$M_5 = fd_1A_2$
1	Web 30x$\frac{1}{2}$ in. 4-Angles 5x3$\frac{1}{2}$x$\frac{1}{2}$ in.	6.10	5.44	f(203)	f(183)	f(193)	f(183)	f(163)
2	Web 30x$\frac{7}{16}$ in. 4-Angles 5x3$\frac{1}{2}$x$\frac{1}{2}$ in.	8.00	7.12	f(263)	f(236)	f(250)	f(238)	f(214)
3	Web 30x$\frac{1}{2}$ in. 4-Angles 6x4x$\frac{1}{2}$ in.	13.88	12.56	f(414)	f(380)	f(396)	f(389)	f(377)
4	Web 30x$\frac{1}{2}$ in. 4-Angles 6x4x$\frac{1}{2}$ in.	13.88	12.56	f(423)	f(388)	f(406)	f(398)	f(377)
5	Web 30x$\frac{1}{2}$ in. 4-Angles 6x4x$\frac{1}{2}$ in. 2-Plates 14x$\frac{1}{2}$ in.	24.38	20.42	f(724)	f(614)	f(669)	f(646)	f(613)
6	Web 36x$\frac{1}{2}$ in. 4-Angles 6x4x$\frac{1}{2}$ in.	13.88	12.56	f(530)	f(485)	f(508)	f(489)	f(453)
7	Web 36x$\frac{1}{2}$ in. 4-Angles 6x4x$\frac{1}{2}$ in.	13.88	12.56	f(557)	f(509)	f(533)	f(508)	f(453)
8	Web 36x$\frac{1}{2}$ in. 4-Angles 6x6x$\frac{1}{2}$ in. 4-Plates 14x$\frac{1}{2}$ in.	33.46	28.62	f(1,140)	f(990)	f(1,065)	f(1,055)	f(1,030)
9	Web 36x$\frac{1}{2}$ in. 4-Angles 6x6x$\frac{1}{2}$ in. 4-Plates 14x$\frac{1}{2}$ in.	33.46	28.62	f(1,165)	f(1,013)	f(1,089)	f(1,075)	f(1,030)
10	Web 48x$\frac{1}{2}$ in. 4-Angles 6x6x$\frac{1}{2}$ in.	16.88	15.56	f(898)	f(828)	f(862)	f(834)	f(747)
11	Web 48x$\frac{1}{2}$ in. 4-Angles 6x6x$\frac{1}{2}$ in. 2-Plates 16x$\frac{1}{2}$ in.	30.88	26.72	f(1,546)	f(1,344)	f(1,445)	f(1,397)	f(1,282)
12	Web 48x$\frac{1}{2}$ in. 4-Angles 6x6x$\frac{1}{2}$ in. 4-Plates 16x$\frac{1}{2}$ in.	40.88	34.88	f(2,010)	f(1,726)	f(1,872)	f(1,820)	f(1,672)
13	Web 48x$\frac{1}{2}$ in. 4-Angles 6x6x$\frac{1}{2}$ in. 4-Plates 14x$\frac{1}{2}$ in.	28.22	23.70	f(1,436)	f(1,226)	f(1,331)	f(1,260)	f(1,139)
14	Web 60x$\frac{1}{2}$ in. 4-Angles 6x6x$\frac{1}{2}$ in. 4-Plates 14x$\frac{1}{2}$ in.	28.22	23.70	f(1,878)	f(1,610)	f(1,745)	f(1,625)	f(1,422)
15	Web 26x$\frac{1}{2}$ in. 4-Angles 6x6x$\frac{1}{2}$ in. 4-Plates 14x$\frac{1}{2}$ in.	28.22	23.70	f(693)	f(594)	f(645)	f(638)	f(616)
16	Cunard Girder	144.00	120.65	f(18,095)	f(15,330)	f(16,720)	f(16,080)	f(14,480)

Notation:
M_1, M_2, M_3, M_4, M_5 = Resisting moment of girder section, inch = pounds.
S_1, S_2, S_3 = Section modulus. In determining section modulus the neutral axis is assumed to be at the center of cross-section and the distance back to back of angles to be one-half inch greater than the depth of web plate.
f = Extreme fiber stress for M_1, M_3, and M_2, and flange stress per square inch of net section tension flange for M_4 and M_5; pounds per square inch.
d = Distance c. to c. gravity of flanges or effective depth of girder, inches.
d_1 = Depth of web plate, inches.
t = Thickness of web plate, inches.
A = Area of each flange (A_1 = gross area; A_2 = net area), square inches.

fourths of the stress used in axial tension; that is, 12,000 where 16,000 is used and 13,500 where 18,000 is used. Unless known to be otherwise the net area would be assumed to be three-fourths of the gross area; this is equivalent to taking 9,000 and 10,125 on gross area.

Rivet Pitch—In determining rivet pitch for connecting flange angles to web plates, if there is no load on the top flange and the flanges are designed to take all the bending moment, the equation $p = rd/V$ is commonly used, in which p is the pitch of rivets, r is the resistance of one rivet (usually the bearing value on the web plate), V is the vertical shear at the section considered, and d is the girder depth. The value of d to be taken varies according to the authority followed. A large number think that it should be taken as the effective depth of the girder, that is, the depth used in designing; another group of writers teach that d should

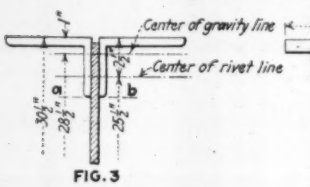


FIG. 3

FIG. 3—RIVET PITCH CALCULATION

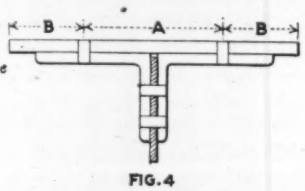


FIG. 4

FIG. 4—COVER-PLATE LIMITS

be taken as the perpendicular distance between rivet lines, while a third group takes it as the depth of the web plate. If one-eighth the web is considered part of the flange area the equation becomes,

$$p = \frac{rd}{V}\left(\frac{F + \frac{1}{8}A}{F}\right)$$

in which F is the area of one flange and A is the area of the web. By the moment-of-inertia method the longitudinal shear per lineal inch between the flange and the web at any section is $h = Vm/I$, in which m is the statical moment about the neutral axis of that part of the flange outside of the section on which the horizontal shear is desired (ab in Fig. 3); then $p = r/h$. The maximum pitch by all methods should be limited to 6 in.

The variations in the pitch obtained by the four methods can best be shown by an example or two. Let the girder section partially shown in Fig. 3 be of four angles 6 x 4 x ½ in. and a web plate 30 x ⅜ in. Assume ¾-in. rivets to be used, with a bearing value of 24,000 lb. per sq.in. or 6,750 lb. for a single rivet. For a vertical shear of 50,000 lb., and no part of the web considered as flange area, the values of rivet pitch p from the foregoing assumed values of d are 3.84, 3.44 and 4.05. If one-eighth of the web is considered part of each flange area, the values of p are 4.41, 3.95 and 4.65. By the moment of inertia method $p = 4.72$.

Again, suppose the girder section to be of 30 x ½-in. web plate, each flange of two angles 6 x 4 x ½ in. and two cover plates 14 x ½ in., the rivets ⅞ in., and the vertical shear 100,000 lb. at the section considered. The values of p from the different values of d, with no portion of the web considered as resisting moment, are 3.08, 2.68 and 3.15. With one-eighth the web considered as part of each flange, p is equal to 3.32, 2.89 and 3.40. By the moment-of-inertia method, $p = 3.51$.

"Without being dogmatic or entering into any discussion the writer expresses preference for the first method mentioned, that is, using the effective depth of the girder in determining the pitch of rivets connecting flange angles to web plates.

Attention is here called to the effect of a change of flange section on the rivet spacing. Where a new cover plate begins there is a redistribution of stresses because the ratio of plate sectional area to entire flange sectional area is changed. Additional rivets are needed around the point where the cover plate begins, in both the vertical and the outstanding legs of the flange angles.

Stiffeners—A goodly portion of the literature of plate-girder design is devoted to web stiffeners. The chief functions of stiffeners are stated by Hudson ("Plate Girder Design," 1911) to be: (a) to keep the web from buckling due to the compressive stresses in it; (b) to keep the compression flange from lateral failure as a whole and from failure in detail in any direction; (c) to relieve the rivets connecting the loaded flange to the web, by transferring the load directly to the web; (d) to reduce to a proper amount the vertical stresses, on horizontal planes, in the web brought by local concentrated loads; and (e) to help hold the web true to shape during manufacture and erection.

Goodman ("Mechanics Applied to Engineering") thinks that the primary function of web stiffeners is to give torsional rigidity to the girder to prevent side twisting. He regrets that he does not see any way of calculating the pitch of stiffeners to secure the necessary stiffness.

Broadly speaking, stiffeners may be divided into two classes, those that act as columns and those that act as beams. Of the first class are those at bearings and those under concentrated loads. Most specifications require that stiffeners in such cases be designed as columns, using in the reduction formula a length equal to one-half the depth of the girder (the column receives or discharges its load in increments). "A rational method would be, first, to assume the full concentration carried by the angles only, using the unreduced stress in compression, and, second, to consider the fillers and the strip of the web plate covered by these as part of the stiffener and dimension the latter as a column against buckling, the larger required section of the angle to be used" (Kunz, "Design of Steel Bridges," 1915). As it is impracticable to secure an accurate bearing of stiffener angles against the fillets of flange angles, the bearing area is restricted to a portion of the outstanding legs. The bearing value may be assumed at 24,000 lb. per sq.in., excluding the chamfered portion over fillets of flange angles. This often necessitates that outstanding legs be as wide as the flange angles will allow. A filler under the stiffener angle equal in thickness to the fillet of the flange angle would allow the whole area to be considered in bearing, in which case the bearing value should be assumed as 16,000 instead of 24,000.

Intermediate Stiffeners—The design of intermediate stiffeners is largely a matter of judgment based upon experience. The persistence with which girders with few or no stiffeners have carried heavy loads upsets all theories. It is accounted for in part by the low stresses used in some of the earlier specifications. The "General Specifications for Iron Bridges" issued in 1879 by the New York, Lake Erie & Western R.R., O. Chanute chief engineer, allowed but 4,000 lb. per sq.in. shearing stress (net or gross section not stated) in web plates. With

such a value it was consistent to specify "when the least thickness of the web is less than one-eightieth of the depth of a girder, the web shall be stiffened at intervals not over twice the depth of the girder."

Until the effect of the tensile stresses acting at right angles to the compressive stresses is known the buckling stresses can not be calculated. Yet the case is by no means hopeless. If stiffeners are spaced according to the methods given in almost any textbook the web is secure against buckling so long as it is thick enough to resist the shear. A simple and common requirement and one based on good reasoning is that intermediate stiffeners shall be placed at points where the thickness of the web is less than one-sixtieth of the unsupported distance between flange angles, generally not farther apart than the depth of the web plate, with a maximum limit of 6 ft. Moore ("Design of Plate Girders," 1913) suggests, since this rule gives a constant spacing regardless of the intensity of shearing stress, that the factor of $\frac{1}{60}$ be multiplied by S_a/S_s, in which S_a is the allowable intensity of shearing stress in the web as determined by the specifications used, and S_s is the actual intensity of shearing stress as determined by dividing the shear at any section where the stiffening spacing is desired by the web area. While theoretically sound, the suggestion would be troublesome to follow in making details. Besides, stiffeners may be needed to keep the web true to shape, if the girder is subject to rough handling.

Since intermediate stiffeners act as beams the greatest strength is secured by having the outstanding legs extend to, or near to, the edge of the flange angles. This also secures the most efficient resistance to lateral deflection of the top flange.

Economic Depth and Weight—Many formulas have been presented for the economic depth and for the weight of plate girders, some of which in taking account of the many variables are quite complicated. While all of them are fairly accurate for girders built under conditions considered, none of them are accurate for plate girders in general. Textbooks usually give from $\frac{1}{8}$ to $\frac{1}{12}$ the span as the economic depth. Definite requirements to be met, however, often fix the depth regardless of the results of mathematical calculations. This is especially true in building work.

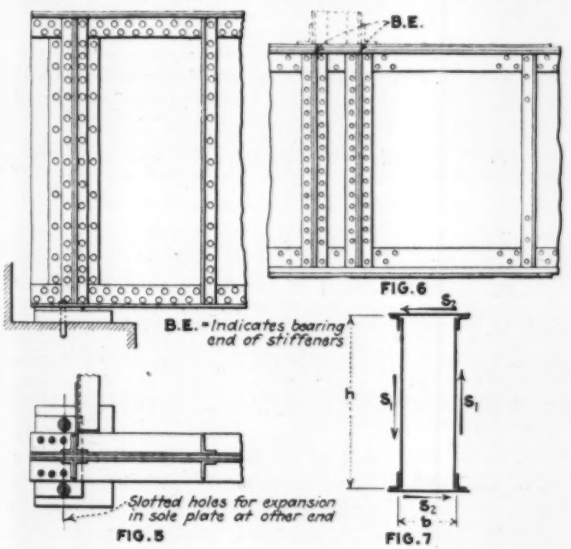
The minimum depth is often given as $\frac{1}{10}$ the span, though for girders subject to shock and vibration such as crane girders and deck plate-girder bridges the depth should be not less than $\frac{1}{8}$ the span. Bird, an English writer, in "The Practical Design of Plate Girders," 1920, deprecates the existence of many plate girders on English roads with depths of but $\frac{1}{15}$ to $\frac{1}{20}$ the span.

An approximate weight of a plate girder can easily be obtained (after determining the web plate and flange area at center) by multiplying the area of the center cross-section by four times the length of the girder in feet. The weight of the girder usually adds comparatively little to flange stresses. The weight of girder 1 of Table I on a span of 30 ft. adds 1.7 per cent to the center flange stresses; in girder 14 for a length of 50 ft. the addition is 5 per cent.

It has often been stated that in a well-designed girder the weight of flanges should equal one-half the entire weight, but there are so many exceptions to this rule that it is not a safe guide.

Stray Points—Many minor points connected with plate-girder design or details need to be kept in mind. For a number of these points (and for Figs. 1, 5 and 6) the writer is indebted to F. L. Castleman, plant engineer of the American Bridge Co. at Pencoyd, Pa.

1. Care should be taken that plate girders are so designed that the flange-stress increments can be taken from the web plate into the flanges by the rivets. This may seem to the reader so elementary that a caution is out of place. Yet until the current year a leading steel manufacturer's handbook, under the caption "Riveted Plate Girders: Safe Loads in Thousands of Pounds Uniformly Distributed," tabulated loads of 200,000 to 300,000 lb. for girders with 28 and 30x$\frac{3}{8}$-in.



FIGS. 5-7—SOME DETAILS OF PRACTICE
Fig. 5—Good arrangement of end stiffeners. Fig. 6—Marking the bearing ends. Fig. 7—Torsional shear in box girder.

web plates and with flanges composed of cover plates on 6x4-in. angles with the 4-in. leg riveted to the web plate; to transmit the flange-stress increments near the ends into these flange angles by a single row of rivets would require bearing on the web plate beyond the permissible value. Thicker web plates should be used, or else 6x6-in. flange angles, giving a double row of rivets in the vertical leg.

2. If the center of gravity of flanges with several cover plates falls outside the angles, the effective depth should be taken back to back of angles.

3. The ends of all girders should be secured against overturning.

4. It is sometimes cheaper to increase the thickness of web plates and either omit the intermediate stiffeners or decrease their number.

5. Although most specifications forbid it, there seems to be no good reason why the thinnest instead of the thickest cover plate should not go next the flange angles, especially when one cover plate extends full length. Material will be saved thereby, and if the lower plate is in two lengths it will be spliced by a plate of greater thickness.

6. Striving after ornamentation or architectural effects is expensive. The design drawing may present a better appearance thereby but the designer should look beyond the mere appearance of his drawing and consider the location of the finished structure. Girders encased in concrete or for a bridge in some wilderness need not be

artistically beautiful. In this connection it may be said that curved ends add to the cost of fabrication, and judgment should be used in requiring them. If they are necessary the radius of curvature should be not less than three (preferably more) times the vertical leg of the angle curved.

7. Lessening the weight of a girder does not necessarily decrease its cost; it may increase it. Curving the top flange to secure uniform stress will save weight in web plates, but the increase in cost of fabrication will more than offset the cost of plates saved. Crimping the intermediate stiffeners will do away with fillers, but unless the girder is deep or the flange angles thick or there is considerable duplication there will be no saving in cost.

8. Having the web plate in one or at most two pieces is desirable from an engineering point of view. But if very long the plates may cost enough more per pound to make it cheaper to use shorter plates with splices.

9. Theoretically, the web plates need not be of uniform thickness throughout. The 110-ft. center girders of the New York Central R.R. bridge near Lyons, N. Y., built in 1901, have web plates 134 in. deep and ⅜, ½ and 1 in. thick. However, for ordinary girders the cost of excess material in a uniform thickness of web plate is usually offset by the saving effected in the cost of fabrication.

10. The work of the detailer is often undervalued. He can easily lessen the efficiency and increase the cost of plate-girder work by poor details. More rivets than needed may be used in some places and too few in others. The strength may be materially reduced by a spacing of rivets that unnecessarily reduces the net section. In the girders of complicated structures, as locomotive and swing-bridge turntables, considerable engineering knowledge is often required to avoid excess of rivets and yet develop the required strength.

11. The detailer will facilitate shop work if he can, without excessive riveting, (a) use the same spacing of rivets in top and bottom flanges, (b) have the spacing symmetrical about the center line of girder, (c) have as few changes in pitch as practicable, and (d) make all lateral plates similar. In any case he should space rivets adjacent to stiffeners far enough away to allow them to be easily driven.

12. The detailer should especially bear in mind the erector. Entering connections should be avoided unless the member can be entered vertically by means of its own weight. Ample clearances should be allowed. Care should be taken that all field rivets can be entered and driven. It should be possible to erect floorbeams in place without moving girders from their permanent position. Anchor-bolt holes in shoe plates of bridge girders should be ⅜ in. larger than the bolts, and should be so located that holes can be drilled in the masonry with the drill held vertically. A washer can be used to cover the hole and provide bearing for the nut.

13. A question that often arises in detailing girders with flange angles of 8- and 6-in. outstanding legs is whether to use two or four lines of rivets in cover plates. On girders encased in concrete two lines are considered sufficient provided the stress increments are taken up and the following ratios are maintained: in Fig. 4 the distance *A* not to be greater than 32 times the thickness of thinnest plate and distance *B* (except as allowed in specifications for cover plates, *ante*) not greater than 8 times the thickness of thinnest plate plus 1 in. For 8-in. outstanding legs, 4 lines of rivets are commonly used; for 6-in. legs 2 lines are usually sufficient.

14. The detailing of splices is important, and its underlying principles should be well understood. If web plates are designed to take a portion of the bending moment, web splices should be detailed to take the same portion. The Lackawanna R.R. specifications, which allow no portion of the web plate to be considered as a part of flange section, nevertheless require the web to be spliced for both shear and moment. The additional factor of strength gained by neglecting the bending value of the web would be lost if the web were not spliced for moment.

15. It is not the best engineering, though more or less common in practice, to have the end reaction taken by a pair of stiffeners at each end of a bearing plate, as the pair at the inner edge will take considerably more than half. It is much better to bring the outstanding legs together over the center of bearing and proportion the bearing plate for concentrated loading. Fig. 5 shows such a detail.

16. It often happens that the shop in endeavoring to secure an exact bearing at both ends of a stiffener fails at both ends. If bearing ends were marked on shop drawings (letters *B. E.* may be used, see Fig. 6) the shop would know which end should have an exact bearing and could work accordingly.

17. Laterals should preferably be connected to gusset plates, and should stop short of flange angles. If diagonals are connected to the flange angles, the unequal deflections at their ends will cause the rivets to work loose owing to the stiffness of the angle. The flexibility of the gusset plate avoids this. Details are also simpler.

18. Intermediate stiffeners for girders that are encased in concrete may without harm be cut at the edge of the fillet of the flange angle. Chamfering the stiffeners is thus avoided. Beveled cuts and refinements made for the sake of appearance, if not exposed to view in the structure after erection, should be avoided.

19. Fillers under stiffening angles and web splice plates on work not encased in concrete or not exposed to the weather need not fit tight against flanges. A clearance of ¼ in. may be allowed.

20. It is expensive and useless to camber plate girders.

Box Girders—When two web plates are used with a space between, the girder is called a box girder. Heller ("Stresses in Structures," 3d. Ed. 1916) defines a plate girder as a girder having a single-plate web, and a box girder as a girder having two or more webs. A more useful nomenclature would be single-webbed and double-webbed plate girders, but it is not likely that this change from present custom will find adoption.

Bridge girders of electric traveling cranes are usually of the box type. In addition to the moment from vertical loads an overturning moment is introduced from walkways on the sides of the girders. When the walkway consists of two or three planks supported by light brackets the overturning moment is small and except in very light cranes can safely be neglected. But when the walkway is entirely of steel and the motor and shaft are placed on the walk several feet from the center of the girder the overturning moment must be taken into account. Crane makers have no standard practice for making provision for this moment. The problem of

determining torsion stresses in a box girder—a hollow rectangular prism with re-entrant angles—has not yet been solved.

The following, developed by the Chicago engineering office of the American Bridge Co., is recommended for adoption in specifications:

The torsional moment in box girders shall be assumed to produce vertical shears in the web plates and horizontal shears in the cover plates. These shears are assumed to produce no bending in the members in which they act and are to be regarded as pure shears. The torsional moment shall be divided equally between the web plates and the covers, that is (Fig. 7), $S_1 b = S_2 h$, where S_1 and S_2 are the total shears in web plates and cover plates, respectively.

Full-length diaphragms shall be placed at all points of applied eccentric loads to distribute the shears properly to the component parts of the girder. Sufficient diaphragms shall be used throughout to maintain the true form of the girder.

The unit stress in the connection between the web plates and the covers, produced by the torsional moment alone, shall be taken as equal to $S_1/h = S_2/b$. This stress acts in a direction parallel to the axis of the girder.

It is better to avoid torsion than to make provision for it. This may be accomplished by means of a light lattice stiffening girder attached to the main girder by horizontal bracing. This outer girder, besides being designed to carry its share of the walkway, can also be designed to serve as a railing. The main girder can then be of the single-web type with the carriage rail placed directly over the web plate.

Box girders are often used for short spans with heavy loads where the depth is limited and the shear excessive, as in foundations where columns are carried on cantilever girders, over assembly or ball rooms, in office buildings and hotels to carry the columns above, and over openings to carry walls.

Box girders are expensive to fabricate and clumsy to handle. Access cannot be had to their interiors for inspection or painting. Field connections to webs must be made by through bolts or by shorter bolts placed by way of handholes left in the web plates. Unless lateral stiffness is needed that can be provided in no other way there is nothing gained by their use. With 8-in. outstanding legs of angles, single-plate girders can be easily made 24 in. wide over cover plates. If this will not suffice, two single-plate girders tied together by diaphragms can be used.

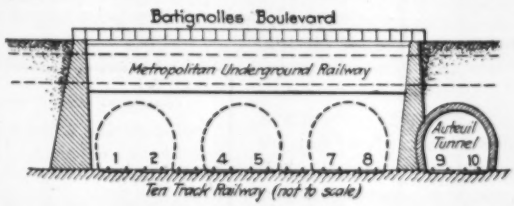
Harbor Works on the African Gold Coast

With a view to the better development of the Gold Coast Colony, important harbor construction work is being carried out at Takoradi, about five miles southwest of Secondee, on the Coomassie Railway, with which the new port is already linked up. On this coast, natural harbors of deep bays of any kind are very deficient, and hitherto steamers visiting the principal ports of Africa and Secondee have been compelled to lie some distance from the shore and make use of lighters and surf boats for trans-shipment to and from the land. The new port will obviate these unsatisfactory conditions by providing a large deep-water basin, sheltered by two breakwaters, together with quay space and storage accommodation, special arrangements being made for handling manganese ore, one of the most important exports of the country.

Open Cut to Replace Paris Tunnels

CONVERTING three of four parallel double-track tunnels into an eight-track open cut with masonry retaining walls is a difficult undertaking now being carried out at Paris to improve the approach to the St. Lazare terminal of the French State Railways.

A short distance from the station the twenty-seven platform tracks converge into an eight-track approach on which are the four parallel double-track Batignolles tunnels, about 1,000 ft. in length. Two tracks are for main-line trains, two for those of the Auteuil line and



BATIGNOLLES CUT AT PARIS

four for the trains of the extensive suburban system. Besides 430 suburban trains each way daily there are numerous light movements, since the locomotive facilities and coach yards are beyond the tunnels. The Auteuil tunnel is to be retained.

For the removal of the tunnels a novel method has been adopted. Each tunnel will be given a heavy lining of reinforced concrete in sections of convenient length. This will enable practically all the earth above them to be excavated without fear of collapse. Then the old masonry will be removed and finally the sections of new lining will be picked up by powerful cranes or derricks.

Since these tunnels pass through a busy city district there were numerous difficult problems in providing for safe and uninterrupted operation of heavy railway traffic and for the protection of streets and buildings. On the surface, each side of the railway is paralleled by a street and in the length of the tunnels there are three transverse streets. Massive retaining walls along the sides of the cut and built-in trenches in advance of the main excavation will support the longitudinal streets. One of these walls will be directly over the side wall of the Auteuil tunnel and will be bonded to it by dowel rods. The finished cut will be 100 ft. wide.

Batignolles Boulevard, which crosses the railway, must be kept open to traffic and here the construction of a double-deck bridge is required since the open cut will intersect a rapid-transit subway of the Metropolitan Ry. crossing above the present tunnels. This bridge will have on the lower deck a double-track electric railway and a number of water and gas mains, electric conduits and cables and a large sewer. On the upper deck will be a broad central parkway, two roadways, a double-track electric railway of the conduit type, and two sidewalks on brackets. Two other bridges will be built later, the streets being closed temporarily.

Clearing the ground over the tunnels was commenced late in 1921, but the work will not be completed until 1925. The estimated cost is about $3,000,000. To still further increase the traffic capacity of the six future suburban tracks all suburban lines are to be electrified, involving about 60 miles of line. It is said that with 8-car trains at 2½-minute intervals the capacity will be 40,000 passengers per hour.

Taxing Gasoline for Highway Improvement

Tax Rates and Taxable Products—Methods and Cost of Collection—Exemptions and Refunds—Penalties and Recovery—Distribution of Fund

Editorial Review

FUELS for motor vehicles are taxed in 33 states to provide funds to be used wholly or in part for highway improvement. During the past winter, the taxation of gasoline was considered in 10 states besides the 16 which have enacted tax laws. In five states having laws prior to 1923 the rate of taxation has been increased. In only five states having no tax law was there no serious movement to enact any. No more conclusive evidence than these figures is needed to indicate that taxation of motor vehicle fuels is considered throughout the country sound procedure for creating funds for constructing and maintaining public roads.

Gasoline taxes are being more and more advocated as the proper and just method of allocating to those responsible the cost of road maintenance. An investigation has just been made by Engineering News-Record *of the status of the gasoline tax in each state of the Union. The results as here presented for the first time bring together the facts about the gasoline tax.*

This extraordinary development of special tax legislation to finance public works invites consideration. In a number of states it gives evidence of having been hastily devised. Adequate advice appears not always to have been secured on the technical questions involved. In some states there seems to have been a deliberate attempt to divert authority from, and to deny the participation of, the state highway department. Lack of co-ordination with existing authority and road development policies is evident. In brief, gasoline tax legislation exhibits the usual idiosyncrasies of law-making by unadvised laymen on engineering administration questions. With a third of the 48 states yet to enact laws and with the certainty in mind that amendment will come up for action in many states, analysis, and a summation of the findings, of gasoline tax legislation is required.

Amount and Rate—It is estimated by the Bureau of Public Roads that a tax of 1c. a gallon on gasoline, as of present consumption, would produce about $40,000,000 annually. This is nearly two-thirds as much as the average annual Federal aid for 1923, 1924 and 1925. Observe that this income assumes no increase in the gasoline consumption of 1922. In 1922 the 17 states named in Table I, which imposed a gasoline tax, collected nearly $12,000,000. In these figures is had the reason for the favor which gasoline tax legislation has gained with legislators. There is no easier additional way of raising large yearly sums of money for road improvement without a general-tax increase and few lawmakers are flirting with the political hazards that this involves.

Tax rates, considering bills introduced and enacted, are 1c. in 19 states, 2c. in 18 states and over 2c. in 5 states. No state has in force or has proposed a rate exceeding 3c. The respective state rates are given in Table II. Examining these rates in connection with the date of legislation, a clear indication is had of a tendency to increase rates. As previously pointed out, five states having laws prior to 1923 have amended them, or substituted new acts, increasing the rate. In a more general way, a count shows that the average rate in the laws of 1923 runs about one-third cent more than in laws of preceding years. A weighted average would show a greater increase. There is altogether convincing evidence that the gas tax rate is mounting. The average for all states is now more nearly 1½c. than the 1c. used by the Bureau of Public Roads in the estimate previously quoted. It is significant too that of all changes in gas tax laws all but one were changes in rates and always the rates were increased: Arkansas from 1c. to 3c.; New Mexico from 1c. to 2c.; North Carolina from 1c. to 3c.; Oregon from 2c. to 3c.; and Washington from 1c. to 3c. The conclusion is warranted that:

1. Rates will increase and not decrease as gasoline tax legislation is extended.

Taxable and Exempt Products—Precise definition of the products subject to taxation and also those exempt is generally lacking in gasoline tax laws. In the law introduced in Kansas exemption is made of all liquids having a flash point of 110 deg. or above. In Mississippi and New Mexico taxable fuels are all not less than "46 deg. Tagliabues Baumé Test." In some states the law names gasoline and no other substance. In general, as indicated in Table III, the law specifies as taxable all liquids used for developing power in internal-combustion engines or for propelling motor vehicles. It appears clear that the intent of legislation is to tax all fuels, with certain stated exceptions, capable of being used to operate motor vehicles of the internal-combustion-engine type. Not all laws state this clearly.

Exemptions are stated in two ways: (1) Certain substances, as kerosene, are exempted by definition; (2) substances for certain uses, as farm tractors or fire engines, are excepted. Of the 29 states listed in Table III, 21 except from taxation certain fuels or fuels used for certain purposes. Kerosene oil alone is exempt in 14 states.

TABLE I—AMOUNTS OF GASOLINE TAXES COLLECTED IN 1922 IN 17 STATES HAVING LAWS OPERATIVE THROUGHOUT THE YEAR

State	Rate	Amount	Reported Cost
Arizona	1c.	$157,000	$1,800
Arkansas	1c.	208,000	Practically none
Colorado	1c.	687,363	Cost nominal
Connecticut	1c.	734,000	Not stated
Georgia	1c.	739,188	No extra cost
Kentucky	1c.	447,550	$1,068
Louisiana	1c.	484,269	Not stated
Maryland	1c.	1,200,000	Practically no cost
Mississippi	1c.	400,000	One extra clerk, $1,500
Montana	2c.	250,000	Negligible cost
New Mexico	1c.	130,000	Practica'ly no cost
North Carolina	1c.	780,000	Practically no cost
Oregon	2c.	1,200,000	$5,000
Pennsylvania	1c.	2,389,211	$50,000 March 1, 1919 to Dec. 31, 1922
South Carolina	2c.	900,000	Not stated
South Dakota	2c.	330,000	Negligible cost
Washington	1c.	950,000	$5,000
		11,885,031	

TABLE II—RATES, COLLECTION AND DISTRIBUTION OF GASOLINE TAXES IN FORCE AND PROPOSED

State	Date	Rate Cents	Payor	Payable	Distribution
Alabama	E. 1923	2	Wholesaler	Monthly	St. 50%; Co. 50%
Arizona	E. 1921	1	Wholesaler	Monthly	St. 100%
Arkansas	E. 1923	3 (a)	Wholesaler	Monthly	St. 25%; Co. 75%
California	I. 1923	2	Wholesaler	Quarterly	St. 50%; Co. 50% (b)
Colorado	E. 1919	1	Wholesaler	Monthly	St. 50%; Co. 50%
Connecticut	E. 1921	1	Wholesaler	Monthly	St. 100% (c)
Delaware	E. 1923	2 (d)	Wholesaler	Monthly	St. 100%
Florida	E. 1923	1	Wholesaler	Monthly	.....
Georgia	E. 1921	1	Wholesaler	Quarterly	St. 100%
Idaho	E. 1923	2	Wholesaler	Monthly	St. 100%
Illinois (e)	.....	.....	.....	.....	.....
Indiana	E. 1923	2	.....	.....	.....
Iowa	I. 1923	2	Wholesaler	Monthly	St. 50%; Co. 50%
Kansas	I. 1923	1	Wholesaler	Monthly	St. 100% (f)
Kentucky	E. 1920	1	Wholesaler	Monthly	St. 100%
Louisiana	E. 1921	1	Wholesaler	Monthly	St. 100%
Maine	E. 1923	1	Wholesaler	Monthly	St. 50%; Co. 50% (g)
Maryland	E. 1922	2	Wholesaler	Monthly	St. 100%
Massachusetts	I. 1923	2	Wholesaler	Monthly	G. 100%
Michigan	I. 1923	2	Wholesaler	Monthly	St. 100% (h)
Minnesota (i)	.....	.....	.....	.....	.....
Mississippi	E. 1922	1	Wholesaler	Monthly	St. 40%; Co. 60%
Missouri (j)	I. 1923	.....	.....	.....	.....
Montana	E. 1923	2	Wholesaler	Monthly	St. 40%; Co. 40%; G. 20% (k)
Nebraska (e)	.....	.....	.....	.....	.....
Nevada	E. 1923	2	Wholesaler	Monthly	St. $60,000; Co. remainder
New Hampshire	I. 1923	1	Wholesaler	Monthly	G. 100%
New Jersey	I. 1923	1	Wholesaler	Monthly	St. 20%; Co. 80%
New Mexico	E. 1921	1 (m)	Wholesaler	Monthly	St. 100%
New York (n)	.....	.....	.....	.....	.....
No. Carolina	E. 1921	3 (o)	Wholesaler	Monthly	St. 100%
No. Dakota	E. 1923	1	Wholesaler	Monthly	G. 100%
Ohio	I. 1923	2	Wholesaler	Monthly	(p)
Oklahoma	E. 1923	1	Wholesaler	Monthly	St. 100% (q)
Oregon	E. 1919	3 (r)	Wholesaler	Monthly	St. 100%
Pennsylvania	E. 1921	1	Retailer	Monthly	St. 50%; Co. 5%
Rhode Island (s)	.....	.....	.....	.....	.....
So. Carolina	E. 1921	2	.....	.....	St. 50%; Co. 50%
So. Dakota	E. 1923	2	Wholesaler	Monthly	G. 100%
Tennessee	E. 1923	2	Wholesaler	Monthly	St. 100%
Texas	E. 1923	1	Wholesaler	Monthly	St. 75%; Schools 25%
Utah	E. 1923	2½	Wholesaler	Monthly	St. 100% (t)
Vermont	E. 1923	1	Wholesaler	Monthly	St. 100% (u)
Virginia	E. 1923	3	.....	.....	.....
Washington	E. 1921	2 (v)	Wholesaler	Monthly	St. 100%
West Virginia	E. 1923	2	Wholesaler	Monthly	St. 100%
Wisconsin	I. 1923	2	Wholesaler	Monthly	St. 100%
Wyoming	E. 1923	1	Wholesaler	Monthly	St. 100%

E., Enacted; I., Introduced; G., General state fund; St., State road fund; Co., County road fund.

Notes: (a) Original law of 1921 establishing 1c. tax repealed by present act. (b) State percentage for maintenance only. (c) Amendment in 1923 allotted tax specifically to road fund. (d) 1c. first year and 2c. thereafter. (e) No bill introduced and "no such bill contemplated." (f) Collected by county and credited to state-aid road fund. (g) State's percentage allotted to maintenance. (h) Pay interest on road bonds and remainder to road fund. (i) Constitutional amendment required. (j) Bill introduced but reported unfavorably by committee and allowed to die. (k) County percentage for maintenance only. (l) No tax bill introduced. (m) Amendment 1923 increased tax to 2c. (n) No bill introduced. (o) Amendment in 1923 raised rate from 1c. (p) The conflict on this provision prevented legislation. (q) To be distributed as state-aid pro rata among counties. (r) Act of 1919, still in force, calls for 1c. tax. Act of 1921, calling for 1c. tax amended in 1923 to call for 2c. Both acts give combined tax of 3c. (s) Little sentiment for and no bill introduced. (t) Allotted to interest on road bonds and to maintenance. (u) Allotted to "laying dust and resurfacing" roads. (v) Raised from 1c. by amendment in 1923.

TABLE III—DEFINITION OF TAXABLE MOTOR CAR FUELS SUBJECT TO TAX AND EXEMPT FROM TAXATION

State	Taxable	Exempt
Alabama	Gasoline, naphtha and other liquid motor fuels commonly used in internal combustion engines.	Kerosene oil, distillates, gas oil, fuel oil and crude oil.
Arkansas	Gasoline. Law names no other product and defines gasoline no further than by name.	No exemptions are mentioned; inference is, all fuels except "gasoline" are exempt.
California	Motor vehicle fuel; any volatile liquid which may be used in operating motor vehicles.	Kerosene specifically excepted from other "motor vehicle fuels."
Colorado	Any product of, or containing, petroleum used for power to propel motor vehicles.	Distillate, crude petroleum, residium, gas or smudge oil.
Connecticut	Gasoline, benzol or other products for propelling motor vehicles over highways.	Road rollers, fire apparatus, ambulances, agricultural tractors and vehicles running only on rails.
Delaware	Motor vehicle fuels; all volatile liquids used for propelling motor vehicles.	Kerosene oil specifically exempted.
Georgia	Gasoline, benzol, naphtha and other fuels commonly used in internal combustion engines.	Kerosene oil.
Idaho	Any product containing petroleum used for power to propel motor vehicles.	Kerosene, crude petroleum, residium, gas or smudge oil.
Kansas	Gasoline and volatile liquid fuels commonly used for operating internal combustion engines.	Kerosene, distillate and other liquid fuels having a flash point of 110 deg. F. or above.
Kentucky	Gasoline (no other fuel named.)	No exemptions named; by inference other than "gasoline"
Maine	Gasoline, benzine and other motor vehicle fuels	Motor boats, agricultural tractors, vehicles running on rails and federal or state owned
Maryland	Motor vehicle fuels; all volatile and inflammable liquids for propelling motor cars	Kerosene oil
Massachusetts	Gasoline and other products in propelling motor vehicles	None indicated
Michigan	Gasoline, distillate, benzine and other liquids for generating power and heat	Kerosene oil
Mississippi	Gasoline; any volatile substance of not less than 46% Tagliabues Baumé Test	None indicated
Montana	Gasoline and distillate	None indicated
Nevada	Gasoline and other volatile and inflammable liquids for propelling motor vehicles	Kerosene oil
New Hampshire	Gasoline, benzol or other products to be used in combustion type engines	Kerosene oil
New Jersey	Gasoline used for motor vehicles on public roads	Gasoline for agricultural or manufacturing purposes
New Mexico	Gasoline; volatile substances not less than 46 deg. Tagliabues Baumé Test	None indicated
North Carolina	Gasoline, benzine, naphtha, liberty oil and all others for operating motor vehicles	Kerosene oil
North Dakota	Gasoline	None indicated
Ohio	Gasoline and all other motor vehicle fuels	Kerosene oil
Oregon	Gasoline and all other motor fuels as distillate, benzine, naphtha and Liberty oil	Kerosene oil
Pennsylvania	Gasoline and other liquids for generating power in internal combustion engines	None indicated
Rhode Island	Gasoline or any of its substitutes	None indicated
Vermont	Gasoline or other motor fuel	Kerosene oil
Washington	Gasoline and other liquid fuels for internal combustion engines	Kerosene oil
Wisconsin	Volatile and inflammable liquids capable of being used in internal combustion engines	Kerosene oil

Conclusions from the information assembled are:

1. Definition of taxable fuels requires study to determine some basis of scientific precision.

2. Distinction, in imposing taxes, between use for motor vehicles and for other purposes is common practice and sound legislative policy.

Tax Collection—Collection in most states is from the wholesale distributor. A number of laws require reports and collect from all dealers, wholesale and retail, with the proviso that the tax shall not be collected twice. A few states require the retail dealer to pay the tax. States with the longest experience favor collection from the wholesale dealer and generally the gasoline trade prefers to pay the tax through the larger distributors. In some states where collection is from either wholesale or retail dealer, the wholesale dealers have voluntarily assumed payment and deliver to the retail dealer, or to consumers in quantity, tax-paid gasoline. There are asserted to be these advantages in collecting from the wholesaler: (1) There are fewer accounts to be

posted and kept balanced; (2) the credit and stability of the wholesale dealer is more certain; (3) the existence of the tax is not made so evident as when the retail dealer adds it to the individual bills of the consumers and, so, there are fewer complaints to handle and less opposition to counteract.

Cost of collection is an uncertain item. The tax is payable monthly in most states and quarterly in a few. Each payment period the dealer reports his sales, generally on blanks furnished by the state collector, and then, or within a stipulated time thereafter, sends his check for the amount of the tax. Generally the state treasurer, comptroller, auditor, tax commissioner or other official authorized to receive the tax requires, to handle the returns, no additional collection machinery other than another clerk or two. It is this fact which accounts for the reports in Table I of "nominal" or "negligible" cost. Obviously there is always some extra cost but it is easy to see how it may be very small. Even in Pennsylvania, where there is a special state bureau for collecting the tax from retail dealers, the cost is only a fraction of one per cent of the amount collected.

From a review of the 43 laws proposed or enacted the conclusions are as follows:

1. Practice and experience favor the collection of gasoline taxes from the wholesale distributors and not from retail dealers.

2. Monthly reports of sales and payment of taxes are required in all but two of the 43 states reporting.

3. Practice favors the collection of the tax by existing state officials, in which event experience shows that the cost of collection is an insignificant percentage of the amount collected.

Tax Distribution—The general idea of a gasoline tax is to provide funds for road improvement. Of the 39 states in which the plan of distribution is known, the tax money goes wholly into the general fund in four states, and partly into this fund in two others. In 21 states all of the money is credited to the state road fund. In 12 states a part of the money goes to the counties for road improvement in the proportions shown by Table II. Use of funds by county or state is stipulated in a few states, notably in the following: California and Maine state percentage, and Montana county percentage, for maintenance; Utah for interest on road bonds and for maintenance, and Vermont for "laying dust and resurfacing."

1. Generally speaking tax distribution follows the distribution of authority over road improvement between county and state.

2. Commonly the use of the money for specific kinds of improvement, as maintenance, is not stipulated but the inclination toward this practice is shown more in recent legislation.

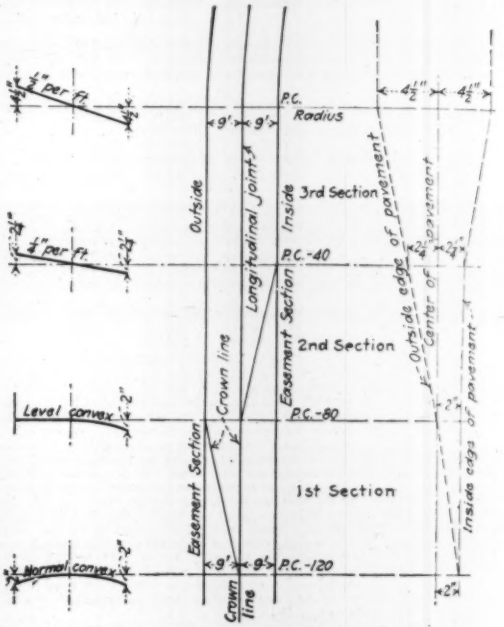
Opposition to Gasoline Tax—Active opposition to taxation of gasoline for improving public roads has been confined to the automobile associations and to the motor truck operators' organizations. Opposition from farmers, motor-boat users and manufacturers, where it has shown any great strength, has been eliminated by exemptions. In the case of the automobile and truck operators' associations, however, little disposition has been shown to concede anything. In a few cases perhaps these associations have this past winter prevented legislation from being enacted or approved.

Simple Method of Banking Curves on Concrete Roads

Transition from Convex Cross-Surface to One-Way Slope at P.C. Made in Three Sections—Extra Forms, Double Screeding Used

By Arthur H. Gardiner
Assistant Office Engineer,
Rhode Island State Board of Public Roads, Providence, R. I.

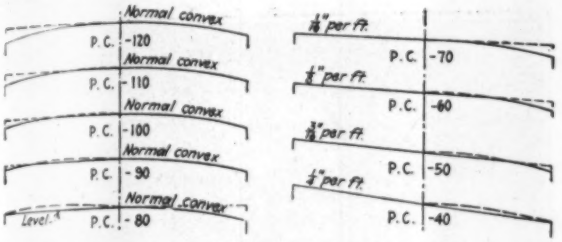
CURVE superelevation on a concrete road, which on its tangents is designed for the ordinary convex cross-surface, is complicated by the necessity of providing a practicable method of effecting the transition from the convex surface to the one-way slope. Any method, to have real merit, must involve little hindrance to the progress of construction; must require as little as possible addition to the standard equipment, and must achieve a result that is graceful, symmetrical and correct from the standpoint of traction. From descriptions



CONVEX SURFACE CHANGES TO ONE-WAY SLOPE ON APPROACH

of various methods of constructing the type of a banked curve discussed, the writer is of the opinion that each of them fails to meet some or all of these requirements. They are either dependent upon a cumbersome system of false forms, troublesome to set and to maintain; they involve intricate calculation, or they result in too sudden changes of surface. From a study of these methods and of the requirements, the following plan is suggested as expedient.

The suggested plan in general provides for the use of temporary auxiliary guides, or forms, superimposed upon the standard forms and employed, on alternate sides, through two successive sections 40 ft. in length. Regardless of rate of cross-fall of the pavement at the curve and regardless of the details of the standard section employed upon tangents, but conditional only upon a uniform rate of approach to the curves, a single set of auxiliary forms, 40 ft. in length, will provide all of the special equipment necessary to do the work for any number, or slope, of curves. The method is designed



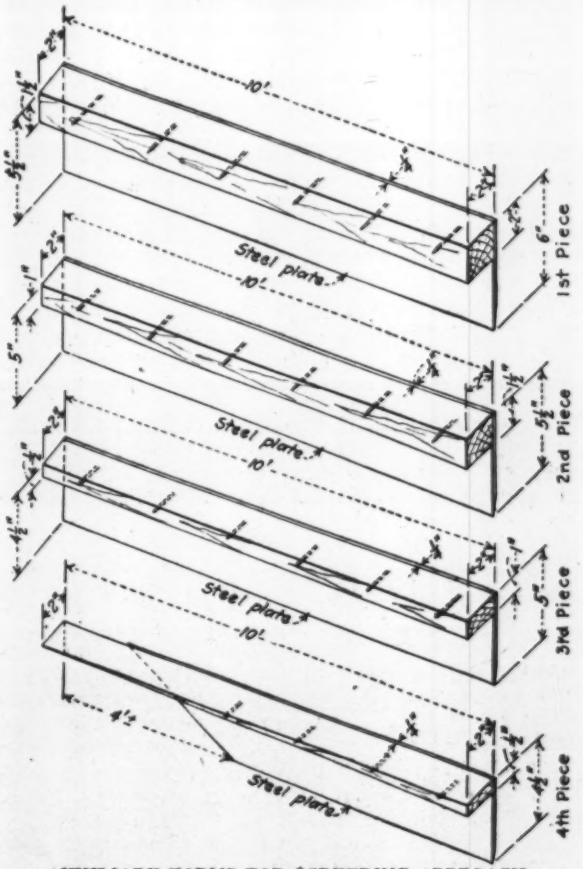
APPROACH SECTIONS AND PROFILES

especially for half-width construction, but it may be employed for full-width construction by inserting a temporary plate longitudinally in the center of the pavement.

In order to demonstrate, let us assume, Fig. 1, that we have to apply this method to the securing of a one-way slope of ¼ in. per foot of width from P.C. to P.T. of a road 18 ft. wide, which, on its tangents, has a standard cross-section that is a convex parabolic curve whose crown is 2 in. higher than its sides. The approach to the curve only will be considered, the departure from the curve being, of course, inversely the same. It is assumed that in the development of the transition from the standard cross-section to the one-way slope desired, the *rate* of cross-fall, or pitch, shall not change more rapidly than ¼ in. per foot in a distance of less than 40 ft. in length. It is further assumed that the entire transition from convex to one-way slope shall take place before the curve is reached. Hence, in passing from a cross-fall of 2 in. on the standard cross-section to a one-way slope of ¼ in. per foot at the P.C., this method assumes that three sections, each 40 ft. long, will be advisable, the first section extending between points 120 ft. and 80 ft. back of the P.C., the second section extending between points 80 ft. and 40 ft. back of the P.C. and the third section extending from a point 40 ft. back of the P.C. to the P.C. If, however, the curve were to be banked to a ¾ in. per ft. slope, it would be advisable to begin the process 40 ft. further back or at a point 160 ft. back of the P.C.

In the first section the road will be eased on the *outside* half, Fig. 2, from the convex curve to a level plane, the inside half remaining standard and convex. In the second section the outside half will tilt up gradually from the level plane to an upward slope of ¼ in. per ft. and the *inside* half will be eased from its convex to a downward slope of ¼ in. per ft., thus bringing the full width of the road to a continuous one-way slope at the end of that section. In the third section the entire road, now in one plane, will rotate on the center from the ¼ in. per ft. slope to a ½ in. per ft. slope at the P.C. Hence it appears that the two side forms should be set to grades which, at the beginning of the first section (P.C.—120) will be 2 in. below the center on both outside and inside, at the beginning of the second section (P.C.—90) will be level with the center on the outside and 2 in. below the center on the inside, at the beginning of the third section (P.C.—40) will be 2¼ in. above the center on the outside and 2¼ in. below the center on the inside and at the P.C. will be 4½ in. above the center on the outside and 4½ in. below the center on the inside, these figures being of course based on the 18-ft. width assumed.

The transition from convex to plane is effected in the following manner: The outside half of the first section is first screeded in the usual manner. Immediately afterward there is placed on top of the standard outside form, a temporary auxiliary form or guide, Fig. 3, of wood or steel or both, tapering from 2 in. above the standard form at its beginning, to nothing at the end of the section nearest the P.C. It will be noted from the preceding data and the accompanying sketches that the auxiliary form is laid to a grade level with the center form for the entire length of the section. After the auxiliary form has been secured to the standard form, by clamps or other fastenings, the section is screeded a second time, this time with a straight-edge resting on the center form and the auxiliary side form,



AUXILIARY FORMS FOR SCREEDING APPROACH

after which the auxiliary form is removed. This double screeding, first with the convex template resting upon the standard forms, and then with a straight-edge, resting on the auxiliary form, functions to give the pavement a cross-section on the outside half with a level crown, always tangent to the convex surface of the inside half, and gradually widening from the center towards the outside until it has merged into a level plane for one-half of the width of the pavement at the end of the section.

On the inside half of the second section the process is repeated exactly as before, using the same temporary auxiliary form. The result here is gradually to extend the plane, already attained on the outside, across the inside half of the pavement until it has reached the full width at the end of this section. The transition is then complete. This method, while explained with reference to an 18-ft. road and a slope of ¼ in. per ft. at the P.C., will be found adaptable to any desired width or slope.

Second Water Purification Plant for Dallas, Texas

Aerator Adjunct to 15 M.G.D. Filter Plant for Removal of Tastes and Odors From White Rock Reservoir Supply

A 700-FT. mixer channel, an 8-step cascade aerator, a perforated-pipe underdrain system and an accessible pipe gallery are features of the new White Rock water purification plant for Dallas, Texas, put into operation in March.

The city has three sources of supply, artesian wells (see *Engineering News-Record*, Jan. 31, 1918, p. 210), the Elm Fork of the Trinity River, which is filtered, and the White Rock reservoir water, which from now on will pass through the new plant. The White Rock impounding reservoir stores 5,700,000,000 gal. of water from a watershed of 114 sq.mi. back of a dam on White Rock Creek at a point about 6 mi. from the city. For several years after the construction of the dam, eleven years ago, fishing, boating and bathing were prohibited and the watershed was protected by policing. But in 1916 an ordinance was passed permitting hunting, fishing and boating but prohibited bathing. In 1920 David Morey, Jr., after making a preliminary investigation and report on the purification of the reservoir water, recommended aeration, sedimentation and filtration through rapid sand filters and chlorination of the effluent. White Rock water is usually low in turbidity or suspended solids, has some color and could be classified as a moderately soft water although provisions have been made in the plant for softening.

FIG. 2—FILTER OPERATING ROOM WITH PLASTERED WALLS AND GYPSUM ROOF

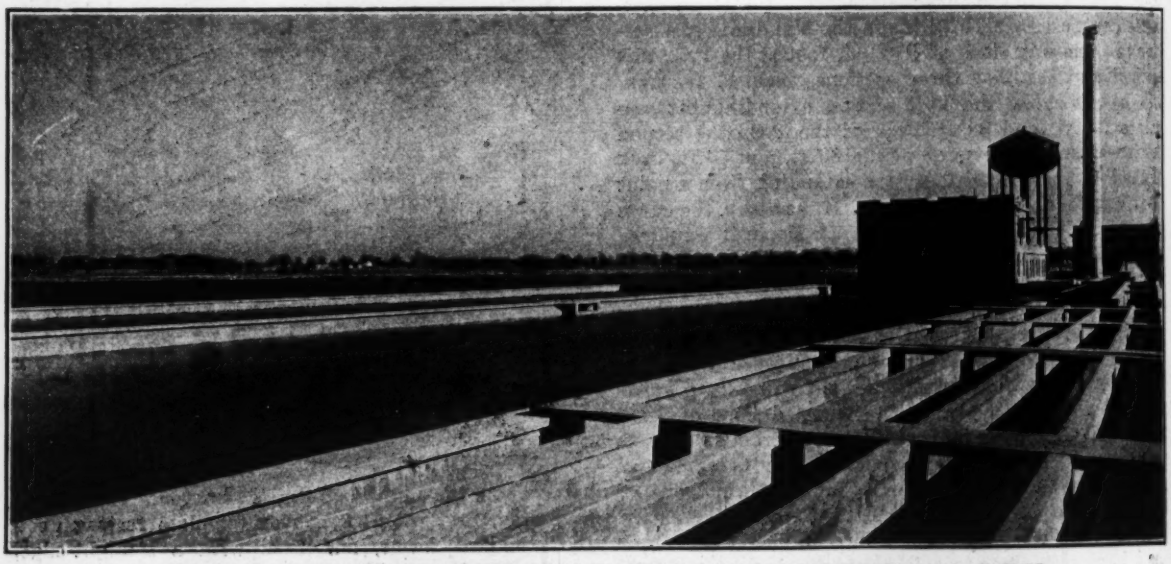


FIG. 1—GENERAL VIEW OF WHITE ROCK WATER PURIFICATION PLANT, DALLAS, TEX.

Five-compartment mixing channels giving 700 ft. travel. At left are settling basins. The filter house is in front of shallow wash-water tank. Chimney and pumping station behind it were built in 1911.

Owing to the fact that White Rock under certain conditions might be called upon to supply the entire city, it was deemed advisable to construct a plant with a capacity of 15 m.g.d. which at a later date could be extended to 20 m.g.d. at a small additional expense. In brief, the plant comprises a low-lift pumping station, an aerator, a mixing channel, two sedimentation basins, one secondary coagulant basin, twelve rapid filters, a filtered-water reservoir and a wash-water tank. The plant complete cost $420,000. Water is pumped from the lake by two turbine-driven centrifugal pumps with water-works type condensers, one having a capacity of 10 m.g.d. and the other having a capacity of 6 m.g.d. From the low-lift pumps the water goes first to the aerator through a 30-in. line in which is installed a Venturi meter tube connected to a registering-indicating-recording instrument located in the pump station.

Aeration—The aerator is a reinforced-concrete structure 90-ft. long, 14 ft. wide and 7 ft. deep, into which the water is discharged through thirty-five 6-in. pipes from which the water falls over eight steps, 86 ft. long. These steps are so arranged that when the water falls over them a cascade is produced. The function of the aerator is to remove the taste and odor. At times the growth of algae is such that it may be necessary to treat a portion of the water in the lake with copper sulphate. From the aerator the water flows through a

channel where the first dose of chemicals is applied. Lime and iron are added through dry-feed machines located in the head house.

The Mixing Channel—The water is next received in the mixing channel, which is a reinforced-concrete structure, 141 ft. long and 21 ft. wide, divided into five compartments. This mixing channel is of the around-the-end type, so arranged that the velocity can be increased or decreased by lowering or raising the depth of water in the channel or by placing stop planks at different points. The depth of water can be regulated by a 42 x 42-in. sluice gate at the outlet of the channel. This gate also regulates the length of time in the mixing channel. The total travel through the mixing channel is 700 feet.

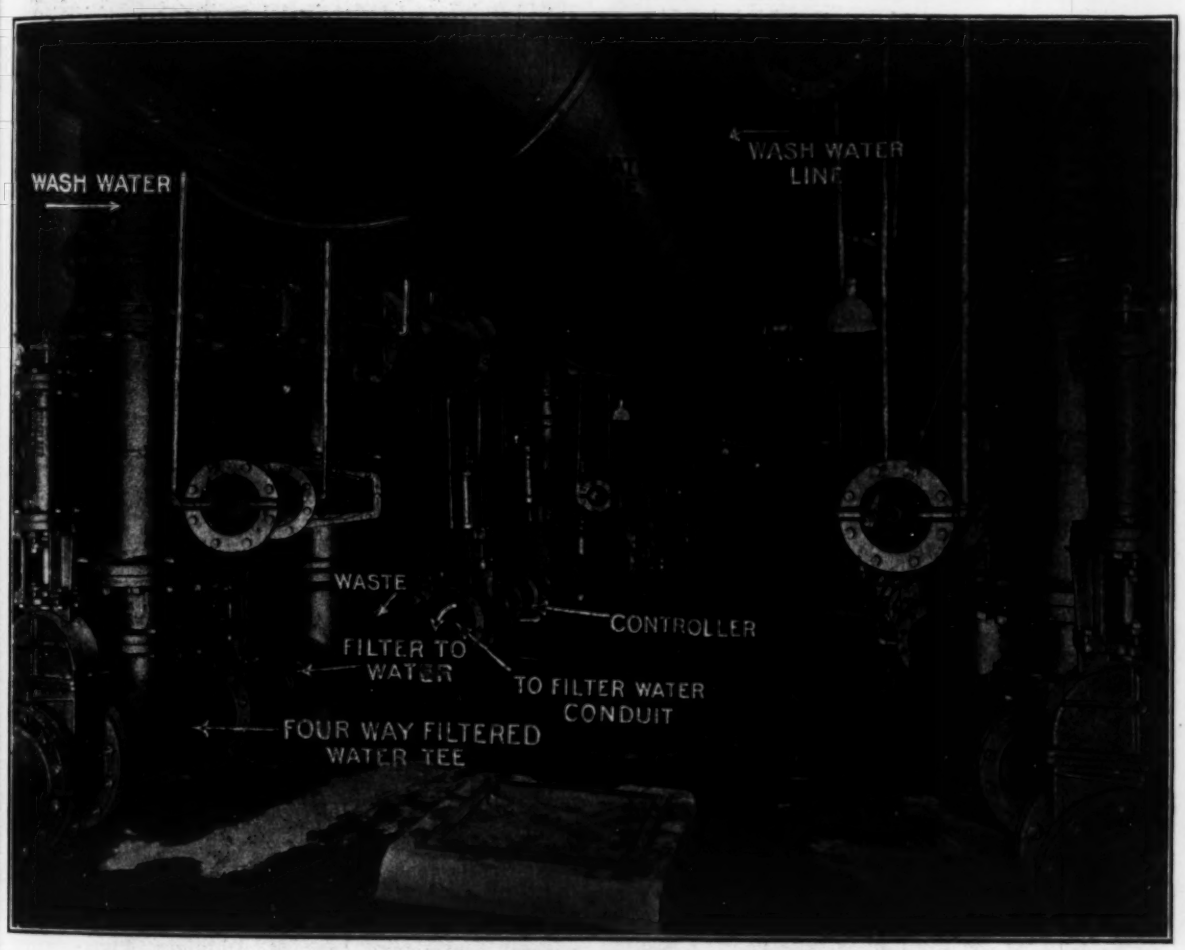


FIG. 3—ACCESSIBLE PIPE GALLERY WITH 6½-FT. HEAD ROOM

Above the 42-in. steel raw-water line is the 24-in. cast-iron wash-water pipe. In the wash-water line is a 24x10-in. Venturi meter tube. Below the floor is a 24-in. sewer and 2½x4-ft. filtered water conduit.

Sedimentation—The two sedimentation basins are each 300 ft. long by 75 ft. wide and under normal operation the depth of water in each basin will be approximately 16 ft. This depth will give an operating capacity of 2,700,000 gal. for each basin. There are no baffles in the basins, but the water in entering the basins is delivered over a weir, in front of which is a curtain wall, extending within 6 ft. of the bottom. The water is drawn off at the opposite end over a weir. It is estimated that practically all of the suspended solids, both from the softening process and from the use of coagulant, will settle out before the water leaves the basin. In consequence provisions have been made for a second dose of coagulant, if required, as the water leaves the basin. In each basin is an 18-in. drain pipe for removing the sludge that accumulates.

The Reaction or Secondary Coagulation Basin—This basin is 74½ ft. long by 24 ft. wide and when operated under normal conditions will contain about 13 ft. of water. Its function is to permit time for the second dose of coagulant, probably alum, to react. The water is then conveyed through a 42-in. lock-bar steel pipe to the filters.

Rapid Sand Filters—The twelve rapid sand filters are designed to operate at the rate of 2 gal. per square foot of filter area per minute. Each filter is a reinforced-concrete box, 17 ft. wide by 28 ft. long and 11 ft. deep, having an effective sand area of 442 sq.ft. Thus when operating at a normal rate each filter will produce approximately 1.25 m.g.d. or a total of 15 m.g.d. for the entire plant. In view of the water to be handled, it is believed that the plant will stand a 20 per cent overload without greatly decreasing the efficiency. The filter material consists of 18 in. of gravel overlaid by 2½ ft. of sand.

The Underdrain System—This consists of an 18-in. cast-iron pipe manifold, into the top of which are tapped

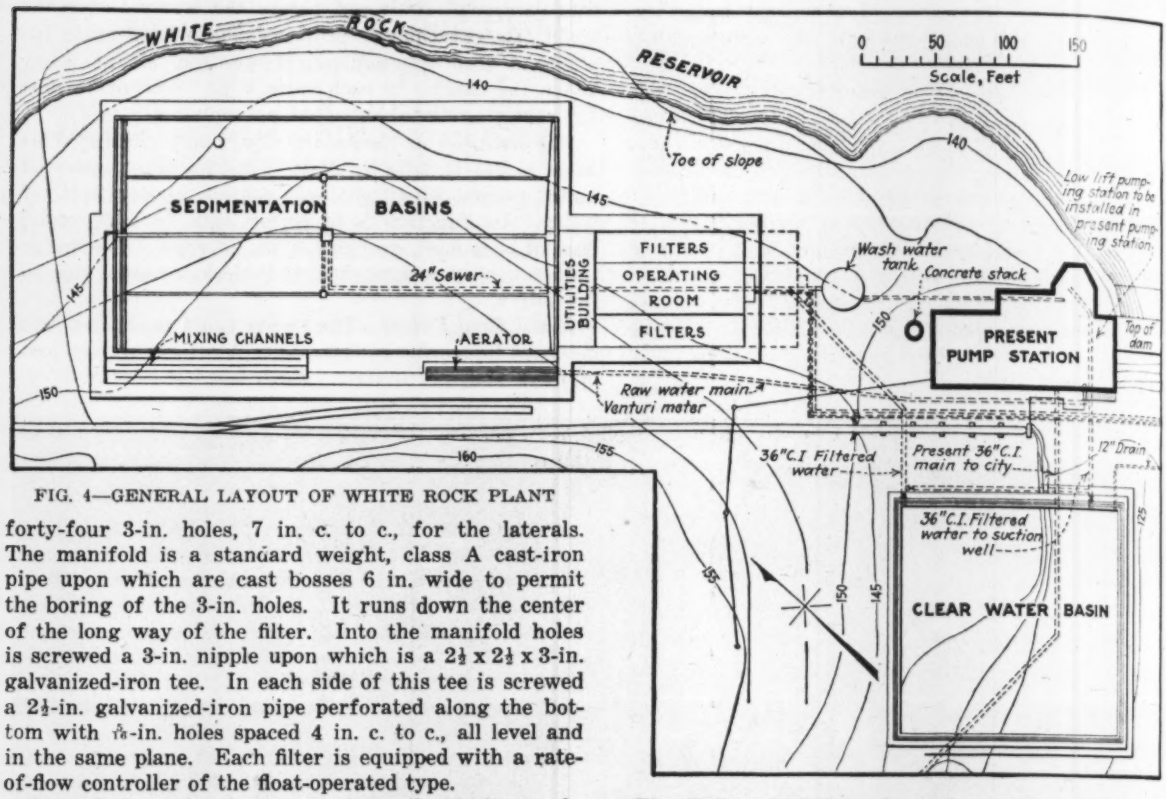


FIG. 4—GENERAL LAYOUT OF WHITE ROCK PLANT

forty-four 3-in. holes, 7 in. c. to c., for the laterals. The manifold is a standard weight, class A cast-iron pipe upon which are cast bosses 6 in. wide to permit the boring of the 3-in. holes. It runs down the center of the long way of the filter. Into the manifold holes is screwed a 3-in. nipple upon which is a 2½ x 2½ x 3-in. galvanized-iron tee. In each side of this tee is screwed a 2½-in. galvanized-iron pipe perforated along the bottom with ⅛-in. holes spaced 4 in. c. to c., all level and in the same plane. Each filter is equipped with a rate-of-flow controller of the float-operated type.

Pipe Gallery—In the pipe gallery the 24-in. wash-water line is above the 42-in. raw-water line and below the pipe-gallery floor is a 24-in. sewer and a reinforced-concrete filtered-water 4 x 2½-ft. conduit. All pipes and valves in the gallery are arranged so that they are easily accessible and give a headroom of 6½ ft. down the center. In the wash-water line is a 24 x 10-in. Venturi meter tube, the instrument for which is installed in the operating room. In addition to the regular indicating-recording instrument a special indicator dial 30 in. in diameter, graduated in gallons per minute, is visible from all parts of the operating room. The object of this dial is to let the operator know at all times the amount of water he is using in washing.

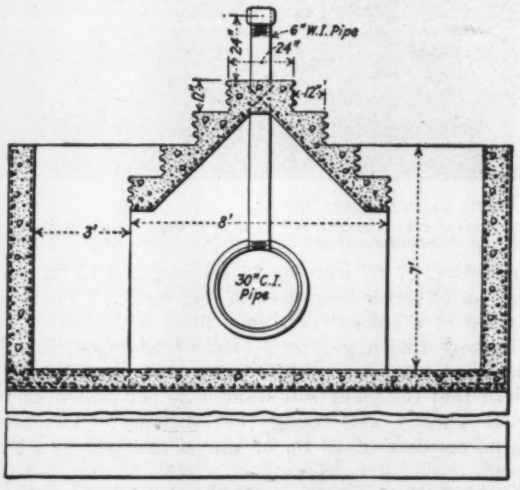


FIG. 5—EIGHT-STEP AERATOR TO REMOVE TASTES AND ODOR

The Utility Building—Over the reaction basin is a two-story structure, the first floor of which contains an office, refrigerating plant, a laboratory for chemical and bacteriological examination of water, a locker room, a store room and the chemical feed machines. Located on the second floor are the chemical store room, shower baths and toilet room.

A steel wash-water tank, 60 ft. from the base of the tower to the bottom of the tank, is 8 ft. deep and has a capacity of 80,000 gal. A tank of this shallow depth was chosen in order to get the least range in head.

Filtered water is stored in a reinforced-concrete basin, 158 ft. wide, 160 ft. long and 16 ft. deep, providing storage for 3,000,000 gal. of water. In addition to the high-duty pumping equipment at White Rock, which consists of a triple-expansion 15-m.g.d. pump installed in 1911, a turbine-driven centrifugal pump with water-works type condenser has recently been installed. It has a capacity of 2,900 gal. a minute against a head of 160 feet.

Four separate contractors installed the new plant. The Hughes-O'Rourke Construction Co., Dallas, was the general contractor; John M. Didinger, Philadelphia, installed the filter piping and equipment; A. M. Lockett & Co., New Orleans, the pumping equipment; and the Pittsburgh-Des Moines Steel Co., Dallas, the wash-water tank. The plant was designed by David Morey, Jr., assisted by Lewis H. Johnson, E. F. Morey and R. B. Pearce. The designs were approved by Nicholas S. Hill, Jr., consulting engineer, of New York.

Wabash Ry. to Lease 70 Miles of M.-K.-T. Ry.

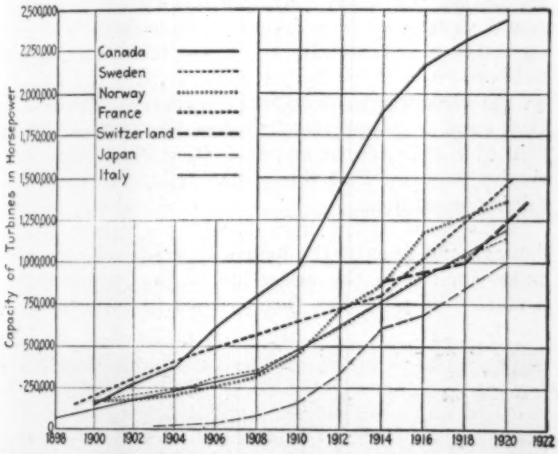
The Wabash Ry. Co. has applied to the Interstate Commerce Commission for authority to lease, with option to purchase, a portion of the Missouri-Kansas-Texas Ry. between Moberly and Hannibal, Mo., 70 miles long.

Twenty Years' Increase in the Use of Water Power

Rapid Increase in Turbine Installations Indicates a Total of Forty Million Horsepower by 1930

By Benjamin E. Jones
Hydraulic Engineer, United States Geological Survey, Washington, D. C.

THE United States was a pioneer in the use of water power. In 1900 the capacity of turbines and waterwheels installed in power plants in this country amounted to more than 3,000,000 hp., while the combined capacity of water power plants in Italy, France, Switzerland, Norway, and Sweden was less than 1,000,000 hp. The capacity of the plants in Canada was then 150,000 hp. and in Japan practically no water power was used. These eight countries comprise all in which the capacity of water power plants in 1920 amounted to 1,000,000 hp. or more, except Germany, and Germany is in such a disorganized condition that accurate estimates for recent years are not available. In 1906 the capacity of water power plants in the United States



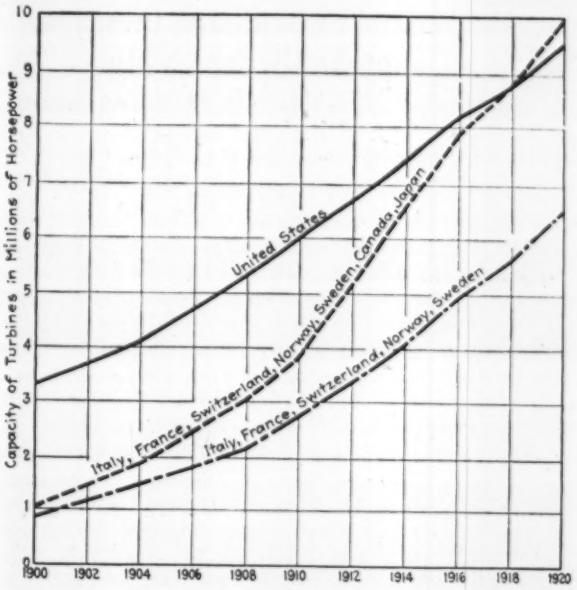
TURBINE CAPACITIES IN SEVEN COUNTRIES OUTSIDE OF THE UNITED STATES

amounted to 50 per cent of the capacity in 1920. Not until 1911 did Canada and the European countries named above reach 50 per cent of their capacity in 1920, and Japan not until 1913.

During the 10-year period from 1900 to 1910 the capacity of new turbines and waterwheels installed in the United States amounted to 270,000 hp. a year—in other words, the increase in ten years was more than 80 per cent. In the five European countries named the rate of increase in turbine capacity during the same period amounted to 185,000 hp. a year, and the rate of increase for the seven countries, including these five with Japan and Canada, was 280,000 hp. a year.

The rate of growth in the United States in the next 10-year period, from 1910 to 1920, increased to 350,000 hp. a year, but, in the five European countries the rate increased more rapidly, reaching 380,000 hp. a year, or more than double the rate in the preceding decade. In Japan, Canada, and the five European countries the rate of growth from 1910 to 1920 was 610,000 hp. a year, an increase of 118 per cent over the 1900-1910 rate.

In the ten years from 1920 to 1930 the rate of growth in the United States will probably increase somewhat,



TURBINE CAPACITIES IN THE UNITED STATES COMPARED WITH SEVEN OTHER COUNTRIES

owing to the operation of the federal water power act, which permits the use, under favorable conditions, of the water power resources on public lands and navigable streams. If the increase amounts to 100,000 hp. a year, the rate of growth will be 450,000 hp. a year, and in 1930 the United States will possess water power plants having a total turbine capacity of 14,000,000 hp.

In Europe, Canada, and Japan plants are being built even more rapidly than during 1910-1920, and as war conditions are gradually left behind the rate of growth will probably increase, as it already has in Canada, where plants with a capacity of 500,000 hp. were added in 1921 and 1922. If the rate of growth in each of the seven foreign countries here considered increases only 90,000 hp. a year, it will amount to 700,000 hp. a year, and in 1930 those countries will possess water power plants with a total turbine capacity of 17,000,000 hp.

In 1920 the eight countries here named possessed 78 per cent of the developed water power in the world. The capacities of plants in these countries in 1930, if the rate of increase is that estimated above, will be 31,000,000 hp., and if the rate of increase in other countries of the world is as great in proportion as in these eight, the total capacity of water power plants in the world in 1930 will be 40,000,000 hp.

The estimates of developed water power in Canada given in this article were supplied by the Dominion Water Power Branch, J. B. Challies, Director. Those for the United States and the other six countries were taken mostly from the World Atlas of Commercial Geology, Part II, Water Powers of the World, published by the United States Geological Survey, Department of the Interior.

Washington Adopts New Type Concrete Bridge

The Washington State Highway Commission has adopted a new type of concrete bridge, the "through" or "bowstring" bridge, in which the supporting arch is above the bridge floor, this type of bridge being particularly adapted to streams of small clearance between high water level and the highway grade, where it is impossible for the arch to be carried below the bridge floor.

Coal Mine Subsidence Damages Concrete Girder Bridge

Collapse of Mine Roof 130 Ft. Below Causes Sinking of Pier and Abutment— Bridge Jacked Up to Grade

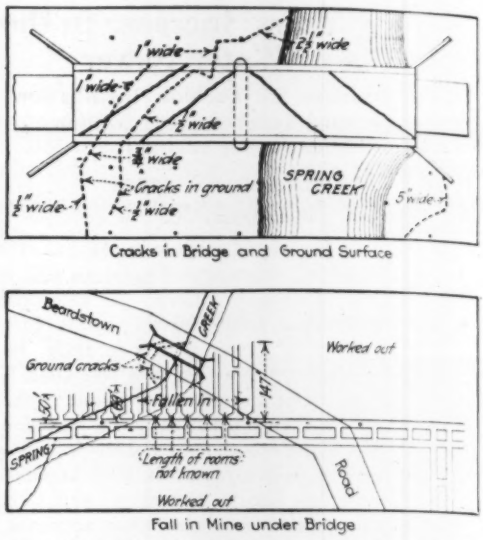
BY G. F. BURCH
Bridge Engineer, State Division of Highways, Springfield, Ill.

AN UNUSUAL case of damage resulting from coal mine subsidence was observed recently in the partial failure of the Spring Creek bridge on the Beardstown road near Springfield, Ill. The bridge is a concrete through-girder structure consisting of two spans of 50 ft. each, with a clear roadway width of 20 ft. The pier and both abutments were founded on solid rock and the bridge was completed early in 1921.

Some time during the night of Jan. 11, 1923, the pier and east abutment sank some distance below grade. Elevations taken on Jan. 13 showed settlement as follows: Pier, north end, 8 in., south end, 16 in.; East abutment, north end, 9 in., south end, 15 in. Two diagonal cracks developed in the floor of each span. The cracks in the west span were the more pronounced and extended through the girders, due to the fact that the settlement of the pier was not uniform and the west abutment, apparently, did not undergo any settlement. The settlements of the pier and east abutment were nearly the same, producing only a very small warping effect, and consequently in the east span the diagonal cracks developed only in the floor slab and not in the girders. The east abutment was badly cracked at each corner but it continued to support the superstructure.

The banks of the stream adjacent to the bridge were examined closely and a number of large cracks in the ground were discovered. This led to the belief that the subsidence was caused by coal mining operations. A few days later an inspection was made of the coal mine operating in that vicinity and it was found that the roof in seven rooms, directly below the bridge, had collapsed on the night the bridge failure occurred. The mine at that point is about 130 ft. below the surface and the vein of coal is approximately 5 ft. thick. This is conclusive evidence that the bridge failure resulted from mining operations.

Steps were taken immediately to prevent further damage and to raise the bridge to grade. By means of jacks applied to the underside of the superstructure, a cluster of piles was forced down to rock under the



Cracks in Bridge and Ground Surface

Fall in Mine under Bridge

FIG. 1—SPRING CREEK BRIDGE AND MINE BELOW

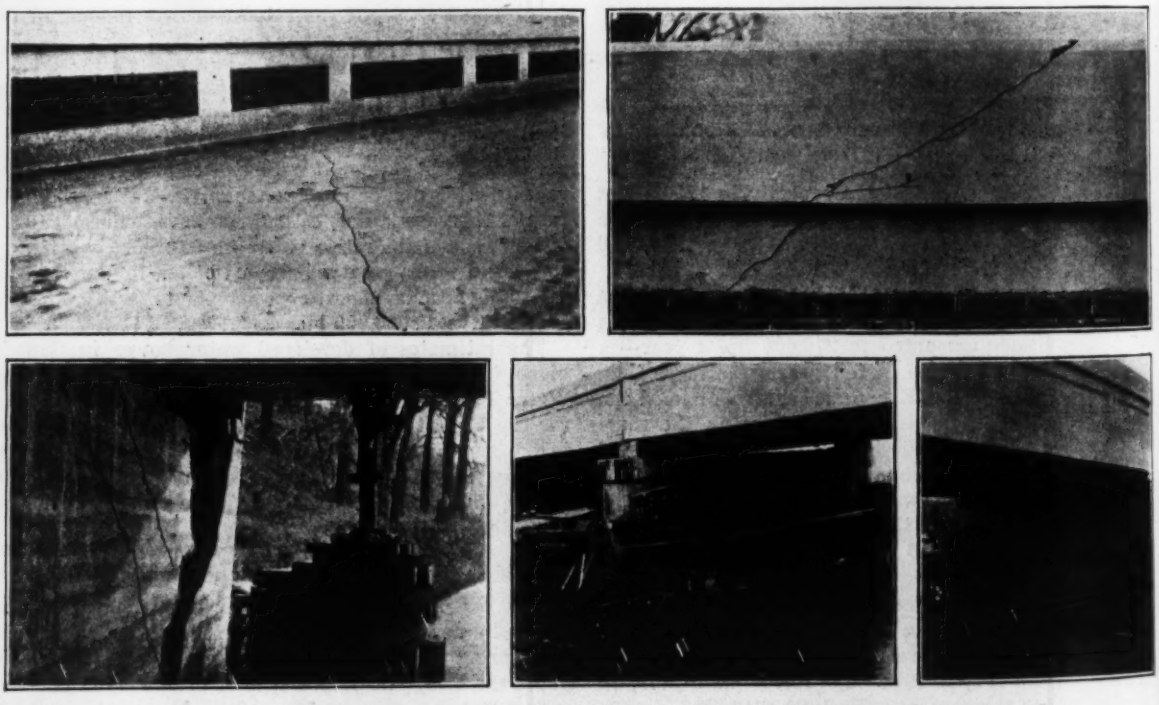


FIG. 2—DAMAGE TO BRIDGE AND RESTORATION BY JACKING

Upper Views: Crack in floor slab and south girder of west span, and near view of crack in coping.

Lower Views: Rupture of east abutment, and jacking operations at pier and east abutment completed.

end of each girder. The piles were sawed off level and chained together, and a grillage of timbers was built upon each cluster of piles, to the proper elevation to receive the jacks. The jacks were applied and the superstructures were raised up to grade. This was a slow operation as each span weighs approximately 220 tons, and it was necessary to raise both spans at once to avoid interruption of traffic. After the spans were raised up to grade pillars of brick masonry were built upon the pier and east abutment to support the girders, and the jacks were released.

The bridge is being allowed to stand in this condition until such time as it appears that the settlement has ceased. At the present time further settlement is practically negligible and can hardly be detected with ordinary surveying instruments. When it appears safe to assume that there will be no further subsidence, more permanent repairs will be made on the east abutment, probably encasing it with concrete. The girders on the west span also will probably be repaired by replacing those portions of the coping (the main compressive area) damaged by the cracks.

Purification Plant for Oysters from Polluted Water

Oysters Cleanse Themselves in Basins of Sea Water Disinfected by Electrolytically-Produced Sodium Hypochlorite

THE successful establishment on a commercial basis of the process by which shellfish which may have been raised in polluted waters are rendered sanitary has been announced by the Conservation Commission of New York, working in co-operationg with the U. S. Bureau of Chemistry and the U. S. Public Health Service. This process has been developed by W. F. Wells, biologist and sanitarian of the commission, from experiments carried out in 1914-15 while with the Public Health Service. The plant has been built at Inwood (L. I.) N. Y., by Sprague & Doughty, the design and construction being supervised by Charles R. Bettes, chief engineer of the Queens County Water Company.

The general features of the plant are as follows: Two concrete basins, each 22 x 25 ft. in plan by 1½ ft. deep, with a capacity of 6,000 gal. each, are capable of handling 400 bushels of oysters in 24 hr. Salt water is obtained from a gravel-filled trench near the basin which removes all suspended organic matter. An electric-driven pump of 125 g.p.m. capacity delivers this water sterilized into the basins. Sterilization is effected by hypochlorite of sodium produced electrolytically from the sea water. A portion of the pumped water passes through an electrolytic cell (Electro Chemical Co.) and thence returns to the pump suction where it becomes mixed with the inflowing water. The strength of the sterilizing solution is controlled by regulating the amount of current entering the cell. An eleven-point switch on the rectifier makes this operation simple.

The details of the process are stated more specifically in the following extract from "Problems in Oyster Culture," printed in the 1922 report of the Conservation Commission's Bureau of Prevention of Stream Pollution:

Process. The object of this process is to sterilize the outside of the oyster and to allow it, by natural processes, to free itself of such infected material as may be in its shell or body cavities. These voided materials are then removed or sterilized. The edible portion of the oyster is not exposed to the action of any chemicals; the animal is merely allowed, in a perfectly natural manner, to wash itself clean in sterile water. The process is as follows:

(1) Oysters of suitable cleanliness are placed in a clean empty basin. One bushel of oysters requires 25 gal. of tank capacity. Oysters must not be in layers over 8 in. in depth and must be so arranged that the water can freely circulate about them.

(2) The basin is filled with water showing, by orthotolidin test, an excess of free chlorine. Amount of chlorine regulated by experience to meet the following requirement.

(3) Sterilizing interval, during which there must be more than 0.2 p.p.m. of free chlorine in the water. Starting when basin is completely full, lasts for thirty minutes, or such longer period as may be necessary to reduce the free chlorine to less than 0.5 parts per million.

OYSTER PURIFICATION PLANT AT INWOOD, LONG ISLAND
Right-hand basin filled with oysters and sea water. Oysters in place in left-hand basin and sea water from settling basin being pumped in through hose. Pump and electrolytic cell in house at left.

(4) Drinking interval starts at end of previous interval and lasts for at least six hours. During this interval the oysters are expected to be open and active.

(5) Basin is drained.

(6) Basin refilled with chlorinated water as in (2).

(7) Sterilizing interval same as (3).

(8) Drinking interval of not less than twelve hours.

(9) Oysters removed, basin drained and cleaned.

The process is not difficult to carry out and the cost is so low as to make it commercially practicable. The current consumed in sterilization is a negligible factor.

Weather Forecasting at Sea Believed Practicable

After a study of forecasting weather at sea, made on the French training ship, *Jacques Cartier*, E. H. Bowie, chief forecaster of the Weather Bureau states that he is convinced that such forecasts are entirely practicable. Forecasting at sea is simpler than forecasting on land areas, because diversified topography does not have to be taken into consideration and cyclones and anticyclones move with more regularity on the sea. During the voyage to and from France, the *Jacques Cartier* received broadcasts of meteorological observations twice a day from Europe and America, and many vessels within range forwarded by radio their observations of the barometric pressure, temperature, wind, weather, and state of the ocean. From these observations weather charts were constructed twice each day and forecasts of wind, weather, and storms broadcasted.

Federal Valuation of Railroads and Its Results

An Outline of What Has Been Accomplished to Date And What Use Will Be Made of the Valuation Figures

By W. A. Van Hook
Consulting Engineer, Chicago

THE ENDEAVOR of the Federal government to inventory and to fix value upon all railroad property used in interstate commerce has reached the stage where within a year presumably the engineering, land and accounting reports will have been completed for all carriers. Final value has been determined in but one case, and this where the carrier made no protest. Hearings are being held at frequent intervals in cases upon value of other carriers. With the initial stage of field inventory completed, the second step of reports showing prices applied to quantities nearing completion, and the work passing from the stage where engineering activity predominated to one where legal activity is to the fore, it is time to look back over the engineering accomplishments and to look forward to the eventual outcome, both as to results in the sense of value of railroad property, and as to effects on railroad finance, rates, accounting, management and public relationship.

In considering the accomplishment to date and the future accomplishment of this engineering activity which has engaged the time of a large number of engineers for nearly a decade, it must be remembered that the dates of valuation of the individual railroads range from June 30, 1914, to June 30, 1919; that the prices applied to units of material and equipment and to structures are intended to be normal as of June 30, 1914, irrespective of the date of valuation; and that each carrier is required to prepare currently in uniform manner a record of additions and betterments to and retirements of physical property subsequent to its date of valuation.

Present Major Results—If no larger accomplishment has been made by this work, there have been certain results of undebatable value, due either directly or indirectly to the valuation activity. Briefly summarized, the major results are:

1. Map and profile records of railroad property as it exists have been created.

2. Up-to-date records of quantities of materials, of structures and of units of equipment have been compiled.

3. Engineering-accounting methods in recording costs and other facts pertaining to physical property have been installed.

4. An impetus has been given to cost analysis in construction and maintenance.

5. The tendency has become established to estimate prior to construction (and to record during construction) complete rather than incomplete costs.

6. A comprehensive knowledge of wear upon and life of property in railroad service has been developed.

7. Basic data necessary to determination and analysis of certain elements of operating expense are now available.

8. Property rights as between owners in complex situations have been defined.

9. There has been established a datum line as to quantities of materials, which may be modified at any time to give facts as of that time.

10. A corresponding datum line as to prices has been drawn, which may be modified readily to state prices of another time.

The Valuation Act of 1913 is responsible for the results so far attained. The Transportation Act of 1920 states how the results of the previous act shall be used, and in so doing brings new duties upon the engineer in railroad service. The act of 1920 requires the Interstate Commerce Commission to "determine and make public what percentage of such aggregate property value constitutes a fair return thereon"; and also requires that "in the exercise of its power to prescribe just and reasonable rates the Commission shall initiate, modify, establish or adjust such rates that carriers . . . will under honest, efficient and economical management and reasonable expenditures for maintenance of way, structures and equipment, earn an aggregate annual net railway operating income, equal as nearly as may be, to a fair return upon the aggregate value of the railway property of such carriers. . . . " In addition the 1920 act provided that for the two years beginning March 1, 1920, a return of 5½ per cent would be fair, with discretion given the Commission to increase this not over ½ per cent for certain specified purposes.

Future Use of Valuation—With the government's valuation machinery in operation for nearly ten years, and the purposes of the valuation defined, it is full time that the legal questions of valuation, the fairness of values as fixed at pre-war prices, the question of what prices and what values are now fair, and the question what constitutes a fair rate of return, be quickly determined.

The future use of railroad valuation has been clearly fixed by law. During the two years now gone by, fair return also was fixed by law, but that two-year period coincided with the time in which occurred the crucial part of business deflation following the war. The fixation of fair return at 5½ per cent for those two years may or may not be a legislative reflection of the very general desire that business, whether manufacturing, merchandising, transportation or what not, get down to earth again. Whatever the reason, and whether that figure be a fair return or not, there was little chance that carriers as a whole would earn any fair rate of return during that time.

The law requires the Commission to do certain things: to determine fair value and a fair return thereon, and to consider efficiency of railroad management in determination of rates which will produce fair return. Indirectly it imposes upon railroad managements the necessity to determine whether waste and inefficiency exist and to correct whatever of such faults are found. Maintenance-of-way and structures cost over one billion dollars in the year 1920. The engineer of maintenance must be prepared to make economical expenditures for maintenance, and to defend the value received for each dollar spent.

The Interstate Commerce Commission must fix fair value and fair return. The law is specific. If the values now being fixed as of given dates are not fair values as of that date, nor fair values as of the present time, there has not so far been recourse to our highest court. If the return is not fair, there will be full evi-

dence of this when our country, once more fully prosperous, fails to invest in railroads upon the basis of the return as fixed.

We are not done with valuation; it has not reached the point of acid test. That point may not be reached until actual use of the value of an individual carrier's property is made. There are still some "Minnesota rate cases" to come, and such cases may be the best means of testing the contentions of carriers and Commission as to fairness. When such cases arise, there will be because of valuation more definite knowledge of facts and more conclusive determination, with rates established in a better way. This country will prosper; it must have better avenues of transportation. Fair wages, fair value of property used and fair return on value are a necessity.

Benefits From the Valuation—The full question of the benefit we will receive from railroad valuation is in the future. Fair value, fair return and greater efficiency in railroad management will come. Valuation will have had no small part in effecting those results. The members of the Interstate Commerce Commission are human; they are affected by political and business eddies and currents just as all of us are. In the end they must give adequate treatment to the questions of value and return, so that there may be more and better railroads for the 150,000,000 population of this country in 1950.

Further Problems—Valuation is the forerunner of other railroad problems which must be met. Rate structures must be established on more scientific lines; accounting methods must be bettered; cost of operation must be more definitely ascertained; division of revenue from through shipments over lines of more than one carrier must be based on analyzed costs to each carrier.

There must be once more an even flow of capital into railroad facilities, and this can only be when there is an incentive to thus invest. Railroad managements, moreover, must acquire an incentive to function at their greatest efficiency.

Sewage Effluent as Boiler Feed Water

Shortage of water supply from a well at a railway water station in a "bad-water" district of the Western States led to the suggestion of the use of effluent from a city septic-tank plant as feed-water for the locomotive boilers. It has been pointed out, however, by a railway water service engineer, that great caution would have to be exercised in the use of such water, since resulting damage to boilers might far exceed any saving in cost of water. It is found that many septic-tank effluents still contain organic matter, and boilers soon leak when decomposing organic matter is in the feed water. If the septic tank has done its work completely, the water would probably be safe for boiler use without further treatment, if the water is reasonably soft. But if the effluent consists of hard water, the process of softening with lime and soda ash should remove organic matter thoroughly. It was considered that such effluent might possibly be used as a last resort for boiler feed water, if always safeguarded by treatment with lime and soda ash. But if a town has water enough for a sewerage system, there will probably be enough for the railroad, and the cost of a well would be small as compared with the continual cost of boiler repairs and interrupted service due to the use of unsuitable feed water.

Railroad Consolidation—Supreme Court and I.C.C. in Conflict

A NEW phase of the railroad consolidation question developed at the hearing by U. S. Circuit Court Judges at St. Paul on May 31, of arguments in the case of the United States against the Southern Pacific R.R. In this case the Supreme Court issued its mandate to the circuit judges to enter a final decree requiring the Southern Pacific to divest itself of any control, either by lease or stock ownership, of the Central Pacific R.R. Co.

After the Supreme Court's decision the Southern Pacific filed a petition with the Interstate Commerce Commission, under the provisions of the Transportation Act, asking the Commission to authorize it to retain its present control of the Central Pacific by a new lease, and by continued stock ownership. This petition was granted by the commission, and now the Southern Pacific has filed a petition asking the circuit judges to enter a decree under the mandate of the Supreme Court to carry into effect this order of the Interstate Commerce Commission. The arguments involve the effect of the Esch-Cummins Transportation Act upon the Sherman Anti-Trust Law.

The solicitor-general, in discussing this effect, said:

It is this feature that gives to this case its unusual character and exceptional interest. The present proceeding concerns not merely the integrity of the judgment of the Supreme Court in one of the most important transportation cases ever submitted to that court for its authoritative decision, but, in its last analysis, affects the integrity of the Sherman Anti-Trust Law. If, in the enforcement of this famous rule of public policy, the action of the courts is subject to the revision of the Interstate Commerce Commission, then the Sherman Anti-Trust Law, so far as the regulation of interstate transportation is concerned, has largely lost its efficacy, and there would seem to be little use in the future of any effort by the government to enforce its provisions in the judicial department of the government when under the interpretation now sought to be given to the Transportation Act the real court of last resort is an administrative commission.

It may be that Congress intended such a radical departure in a policy to which it has now tenaciously adhered for nearly thirty-three years, and it may also possibly be an act of wisdom to transfer the whole question of permissible monopolies or restraints of trade in interstate transportation from the rigid enforcement of the Sherman Anti-Trust Law to the more elastic discretion of an administrative tribunal.

In conclusion the solicitor-general said:

It may well be that the settlement proposed by the commission, which has, at least for the time being, harmonized the long-standing differences of great transcontinental carriers, will better subserve the public interests than the absolute divorce which the Supreme Court, enforcing the Sherman law, has decreed.

Nevertheless, the question remains whether, after the Supreme Court had adjudged that the control of the Central Pacific by the Southern Pacific was unlawful as destructive of competition, the commission could disregard such finding and declare otherwise.

After the hearing was concluded Judge Sanborn said that the Circuit Court of Appeals did not believe that the Supreme Court had considered the Transportation Act in rendering its decision; that the Circuit Court had concluded to enter a decree to the effect that the Interstate Commerce Commission had power to authorize and approve the control by lease and stock ownership of the Central Pacific by the Southern Pacific Co.

Developments in Co-operative Engineering Courses

A Review of the Various Alternate Industry and Class-Room Courses Given in Different American Colleges

By R. L. Sackett
Dean of Engineering, Pennsylvania State College, State College, Pa.

A paper delivered before the Fourth Industrial Conference, Pennsylvania State College, May 26, 1923.

By co-operative education we mean that method by which a student spends a certain period in the pursuit of classwork which is then followed by a period spent in an industry, to be followed again by the return to the class-room and thus alternating between the class-room and the industry. The earliest organization of work of this character on a scale of any importance was at the University of Cincinnati where, in 1906, students were placed in the shop for a period of two weeks and then returned to the university for a corresponding period and thus alternating through the year. If the class consisted normally of thirty students, there would be two groups of thirty, one of which would be in the class-room while the other was learning in the machine shop; and when the group in the machine shop returned to the university, those who had been studying for two weeks took their places in the shop. This period of two weeks has been open to considerable discussion by different institutions which employed different periods in the class-room but all of them spend an equal period in the industry and in study.

The University of Cincinnati Plan—The co-operative plan at the University of Cincinnati has grown so that it includes a wide variety of lines, such as civil, electrical and mechanical engineering. The number of students has correspondingly grown also, and while an alternative was offered until 1920 and students might devote their entire time to the class-room there were fewer each year who did so. The majority preferred the co-operative scheme. Students are employed in the industries not only of Cincinnati but of Dayton, Springfield, Columbus, Cleveland, Detroit, Pittsburgh and a few are in even more remote places. So long as the distance between the industry and the university is not more than a night's ride, the distance is not considered as an important factor in the plan or an objection to it. The period of study and of practice was recently changed to one month.

At the University of Pittsburgh, the period chosen for study is four weeks and this is followed by four weeks of work in the industry. The University of Pittsburgh confines its co-operative work to the industries in the Pittsburgh district because of the greater ease of supervision and because most of the students at the University of Pittsburgh in co-operative courses live in that district.

When the co-operative plan was adopted, the course at the University of Cincinnati was increased from four years of about nine months each to six years of nine months each. The plan has recently been changed to include five years of eleven months each—a net increase of about nineteen months or two college years.

At the University of Pittsburgh, the co-operative instruction is confined to the second and third years. The academic year is divided into three terms and the summer period is also utilized making a four-quarter plan in effect. The co-operative course includes a total of four college years and three summer periods or fifteen terms. Eleven terms are spent in the institution or only one less than the usual number in a four-year course of three terms to each year. The total time of fifteen terms is three more or nine months longer than the usual four-year course.

The Massachusetts Institute of Technology Plan—The Massachusetts Institute of Technology has still another form of co-operative technical education instituted at the Lynn Works of the General Electric Co. In this instance, the normal period of employment in the industry is three months followed by a corresponding period in the institute. However students do not begin the co-operative plan until two years after entering the institution, so that the scheme is carried out only for the last two years of the course. The academic year is divided into three terms of about three months each and the summer period is about the same in length. The total length of the course is five academic years and four summer periods or about fifty-seven months' gross time except that vacation periods between terms reduce the net time about a month per year.

The Harvard University Plan—At Harvard University, students in civil, electrical, sanitary, municipal and mechanical engineering may spend three periods of one-half semester each in practical work off the campus. About one-half the students in these courses do so. The co-operative plan mentioned is required of those taking the five-year course in engineering and business administration.

The New York University Plan—At New York University, a more radical plan has been adopted. Under the plan adopted at the universities previously mentioned, it is necessary to repeat each subject every four weeks if that is the period which the student spends in the class-room. The consecutive time given to study of a particular subject is reduced, and the instructor changes his group and turns back to where this group left off. This involves no greater teaching cost providing that there are enough to make two classes in each subject. If the number of students is fewer than twice the normal number in a class, then the teaching cost is greater as a result of the co-operative plan.

At New York University it is proposed to alternate the work of the junior and senior years in order to avoid teaching each subject twice. While this may economize in cost of instruction, it introduces an even more serious problem. In engineering courses there are well defined sequences of subjects and of prerequisites for the profitable pursuit of advanced subjects. This plan of New York University would sacrifice some of the prerequisites and the logical order of subjects. The period of alternation is four months—the longest so far proposed. Juniors and seniors would not be in college at the same time. The course will occupy four consecutive calendar years and two semesters (about eight months) except for a vacation period of four months at the end of the freshman year.

The Antioch College Plan—Antioch College, reorganized under its new President, Arthur E. Morgan, offers administrative curricula with considerable latitude in the selection of courses. The college has one shop building and proposes to erect standard factory buildings for production work on a profitable basis. It is planned to make the shop work self sustaining and a financial aid to the students. At present the college is sending students to outside plants for their practical work. About 160 students are working or studying under the co-operative plan. It is reported that several thousand have applied for next year.

Worcester Polytechnic Institute has maintained a pattern shop, foundry and machine shop for commercial production since its founding in 1869. Students work here much as apprentices or helpers would alongside the journeymen who do most of the work. Students receive no pay. Juniors spend a year and three months in practical employment on pay with one of several co-operating corporations.

We see how education has changed from the old classical course which was study, reading and recitation to recitation, laboratory instruction, drafting room and shop work, as a result of our industrial development. The co-operative plans abandon or modify the use of college shops and substitute the shops and organization of industrial plants for a part of the practical instruction. The same plan is being adopted in common school education of which the continuation school is one phase.

Advantages of Plan—The advantages of the plan are:

The college is relieved of the capital cost of shops and of their cost of operation in part.

Actual production standards and labor conditions are substituted for the more or less artificial ones of college life. Speed is emphasized and the college adopts to a degree the standards of industry as its standards.

Industrial experience co-ordinates practice and theory more closely.

There is a closer co-operation and better understanding between industries and the college, including the college graduate.

A student may be helped in finding himself and the kind of work which he should do.

Students who are not practical are eliminated early from production lines and seek a place in some other activity.

The students get a taste of plant discipline, meet the shop men and appreciate the value of the practical man in industry.

The corporation has an opportunity to study students, get the judgment of foremen and in a measure to select desirable men for employment after they graduate.

Disadvantages of Plan—The disadvantages are:

Time from entrance to graduation is prolonged, which is not a serious matter if the student has made progress commensurate with the added time.

While the cost of college shops and of their operation may be decreased, there is an added cost for supervision either to the college or to industry or to each if the purpose of education is really served.

The short periods of alternation cause more commotion and more lost motion in starting and stopping than the longer periods of a term or semester.

The co-operative student is prevented from taking part in athletics, in class activities, in college editorial, debating and musical activities, at least to the same extent as students in the usual four-year course.

The co-operative student cannot get the same college spirit that the regular resident student gets.

The most serious objection is to the materialistic view of life being early impressed on the student. Many of the ideals of a cultural education are in jeopardy if they have not already been sacrificed. To put an immature freshman into a shop, the ideal of which is production, is to emphasize materialism so much earlier. The sacrifice will be made no doubt but should college cultural life be sacrificed so early to industry? The ideals of the executive staff may be the very highest but the youthful student in the average shop does not meet them. He gets the workman's philosophy and the company policy as to production. Industrial ideals do not shine through with clearness if at all.

At Pennsylvania State College the industrial shops are a part of the equipment for teaching industrial engineering and for the instruction of students in other courses. Our industrial engineering course teaches the methods of production, planning, routing, the selection of machine tools, factory planning, organization, welfare, wages and personnel. Our teachers are men of experience. What then is the difference between students learning here and in a Philadelphia plant? We do not teach the methods of one plant but the best practice selected from many plants. We are not so much concerned with making money as in helping students to get good information, the best principles and some preparation for the business of engineering, the business of life.

After graduation from the usual four-year course the student begins at the same place in the same shop perhaps but he is more mature; he has received all that the college has to give or all that he chose to get. Normally he is not put through the stages of shopwork which the co-operative plan requires. He may go into design or sales or testing work and not do shopwork after he leaves the campus.

If we assume that the college shop is practical, that the variety of work presented is well selected; if the industrial standards of discipline are good; if the purpose is to teach good production standards, machine-tool selection, jig and tool design, shop planning, safety, welfare and organization, then what is the compensating virtue of co-operative education? (See article by Prof. Roe, in *Management Engineering*, Feb. 1, 1923.)

We are firm in the belief that it is not our province to give trade training and that we are responsible for a broad cultural course with a professional outlook; that we are responsible for thorough instruction in the fundamentals and for planting such standards of life in the minds of students that they will be able to serve society according to their capacities, to enjoy their work and to use their leisure to advantage.

Is co-operative education a more efficient means of bringing the student to find himself and his life work? Is it an expedient or a real educational process? On this question we want your thoughtful judgment and shall appreciate all the evidence which you can present.

Importance of Water Service Pipe Construction Records

By John P. Wentworth
Assistant Engineer, Metcalf & Eddy, Boston, Mass.

In several states the utility commissioners compel the water companies and other public utilities to pay for the laying of the services from the street mains to the curb or property lines. For the first few years after such regulations are made the cost of services is small compared with the cost of the entire plant but eventually their cost becomes a considerable percentage. Thus, in two large water company plants recently valued, the cost of installing new services and relaying old services from the street mains to the curb lines, for a period of four years, averaged 12 per cent of the cost of the entire construction work for the same period.

In valuations for purchases, condemnation, and rate cases the value of the services from street mains to curbs, if installed at the expense of the company, should of course be included. It is the object of this article to call attention to the fact that careful records of construction of services should be kept, so that inventories can be accurately and quickly prepared and so that reliable data can be obtained for determining costs. The construction slips should show the kind, size and length of pipe, the size of fittings and cocks, and a detailed estimate of the cost, separated as far as possible between the section from the street main to the curb line and the section from curb to building.

Most companies keep such records, although some do not distinguish between new services and renewals. There is one item, however, which is seldom kept as a part of the records, and that is the length and kind of pavement cut. Although the cost of cutting pavements is relatively small, the work of preparing an inventory without past records may be difficult and costly. The amount of ledge and difficult excavation in service trenches may be estimated from the quantities encountered in the laying of the street mains but the amount of pavement cannot be so estimated. The street mains may have been laid many years before the services were laid and when there was no pavement present. The services in any one street may have been laid in many different years and the street may have been repaved several times, which would add to the difficulty of preparing an inventory. Many services are renewed just before a permanent pavement is laid and in such cases the records should state the number of feet and kind of pavement removed.

The above comments on pavements apply chiefly to cases where the court or commission rules that the company is entitled only to the value of the pavements actually cut, instead of to cases where the company is allowed the reproduction cost of cutting and replacing all pavements.

It will take a negligible amount of a foreman's time to add the pavement data to his construction slip. This information will save time and money.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Home-Made Railway Ditching Car

A HOME-MADE railway ditching machine on the Toledo division of the Pennsylvania R. R. is found economical in constructing and shaping ditches on level ground and through shallow cuts and also for shaping or dressing the roadbed and ballast shoulders for both cuts and fills. This machine is shown in the accompanying views.

On one side of a steel flat car is erected a timber frame carrying the topping lifts attached to the head

DITCHING CAR ON PENNSYLVANIA R.R.

Above; plow and frame in operating position. Below; plow raised for transportation.

of a frame hinged at the opposite side of the car. To this latter frame is attached a large steel mold-board or plow fitted with a templet for forming standard sections for ballast, roadway and ditches. The cables pass over struts on the hinged frame so as to give a more effective pull in raising the plow and frame. They are operated by a hand hoist anchored to the floor of the car. In this way the frame and plow are raised slightly to clear such obstacles as bridges, rail rests and mile posts. For transportation, the frame rests on the floor of the car and all parts are then within clearance lines.

In service, the hinged frame is lowered to the desired position and as the car is pushed forward by a locomotive the nose of the plow cuts the material for roadway shoulder and ditch, while the inclined mold-board carries this material beyond the ditch line. The machine works best in cuts not more than 2 ft. deep to top of rail, two or three runs being required to form the completed ditch under such conditions. Although it cannot be used in shaping the shoulder of stone ballast it will form the sub-ballast, roadbed and ditch outside of the stone ballast. The work is cheaper and gives a more uniform section than can be obtained by hand work or by teams with scrapers.

An example of the work is the cutting of 11,060 ft. of ditch in a working time of 2 hours 44 minutes, the surface of the ground being from one to two feet above rail level. Average daily cost, at labor rates of July, 1921, is about as follows: 8 hours for foreman at 55½c., $4.44; 40 hours of five trackmen at 40c., $16; work train service, $100; total, $120.44. This gives a cost of 1.1c. per foot of ditch. This cost would be materially lower if the machine could have longer working time, but as it has to be kept clear of traffic this time is restricted.

The machine was designed by Paul Jones and R. C. Miller, formerly division superintendent and division engineer, respectively, of the Toledo division. Information as to its operation and work has been furnished by W. R. Hillary, the present division engineer, Toledo, Ohio.

Slide Rule for Solving Manning's Formula

BY H. B. MUCKLESTON

Chief Engineer, Lethbridge Irrigation District, Lethbridge, Alberta, Canada

THERE have been published in this journal several descriptions of special slide rules designed to solve Manning's formula for the velocity of water in channels. This formula is so easily handled by the ordinary slide rule that the construction of a special rule hardly seems to be a paying proposition. However, for those incurably addicted to the habit, a special rule is a convenience and to them the following may be of interest.

Manning's formula may be written as two identical ratios,

$$\frac{V}{r^{\frac{2}{3}}} = \frac{1.486 s^{\frac{1}{2}}}{n};$$

and, given any three of the quantities concerned, the fourth is readily found. If the four scales A, B, C and D of the ordinary Mannheim slide rule be graduated for the four quantities, A for V, B for $r^{\frac{2}{3}}$, C for n and D for $1.486 s^{\frac{1}{2}}$, then, no matter how the slide containing the B and C scales may be set, any two opposite readings on the A and B scales and any two opposite readings on the D and C scales will satisfy the equation as given. In any statement of the problem three of the four quan-

tities are known and two of these three must be either on A and B, or on C and D; therefore if the slide be set to bring the values of the known pair opposite each other the unknown fourth quantity must be opposite the known third on the other pair of scales.

The rule is very easily constructed if a suitable foundation be available. A student's rule, price $1.50, is a very good foundation but one is easily made. The graduating can be done without calculation if a scale of logs (the A scale of the ordinary rule) is available. Starting with an ordinary rule the A scale is left undisturbed, but it should be figured from 0.1 to 10 instead of 1 to 100 as usual.

For the B scale, giving $r^{\frac{3}{2}}$, we require a scale of logs $\frac{3}{2}$ as long with the index (log 1.0) in the middle. Using a pair of proportional dividers both ways from the center, set off $\frac{3}{2}$ log r and figure r from 0.1 to 10.

Both n and s are usually small fractions, hence their logs will be negative, or have negative characteristics; n ranges from 0.008 to 0.1; s ranges from 0.000,01 to 0.1 and $s^{\frac{1}{2}}$ from 0.003 to 0.3. To keep these graduations on the rule it is necessary to shift the index (log 1.0) to the right, the exact shift is not important but must be the same for both C and D scales.

The D scale must represent $1.486 s^{\frac{1}{2}}$. We will therefore call the index of this scale 0.001 and we will set it opposite the index of the A scale (log 1.0). From this point, using the proportional dividers as before, set off log s to half the scale of the logs on the A scale both ways and figure the graduations from 0.000,01 to 0.1. There will be four units.

The C scale must represent n, which will be to the same scale as the graduations on A. However, we must shift the index to agree with the D scale. From graduation 0.0001 on the D scale set off to the left log 1.486 as measured by the A scale and figure this point 0.01 on the C scale. From this point set off the logs to the same scale as on A and figure from 0.008 to 0.08, which will be sufficient.

The figure herewith is a sketch of the rule as it would appear if set as graduated, i.e., $V = 1$, $r = 1$, $s = 0.0001$, $n = 0.01486$.

If conditions of the problem make it necessary to consider values of V greater than 10.0 or of s greater than 0.1, the indices of V and s may be supposed shifted one whole unit to the left, or in other words the values figured on the V scale may be multiplied by 10 and those on the s scale by 100.

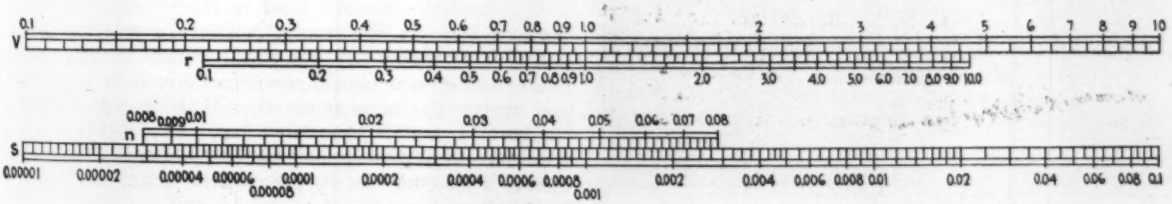
For example: With the slide set as shown in the illustration the following problem might be solved:

$s = 0.0002$, $n = 0.021$, $r = 3.0$, hence $V = 2.08$,

or by assuming the indices shifted one unit, we would have for the same graduations:

$s = .02$, $n = .021$, $r = 3.0$, and $V = 20.8$.

The finer graduations have been omitted from the figure.



SLIDE RULE FOR MANNING'S FORMULA FOR VELOCITY OF WATER IN CHANNELS

Nine-Room House Moved to New Site by Motor Truck

A NINE-ROOM house estimated to weigh 75 tons was recently towed four city blocks along the streets of Los Angeles by a 5-ton truck carrying 8 tons of pig iron ballast to give traction. Occasional stops were necessary to raise wires or to cut the limbs of trees, but where there were no obstructions progress was rapid. One continuous pull of 400 ft. was made at a speed of about 2 miles per hour. This rapid rate of travel was made possible by the fact that no block and tackle was used, the truck pulling directly on the timbers carrying the weight of the house.

The house was first jacked up from its original location with 10-ton jacks and supported on 12 x 12-in. beams extending for its full length and width. The two lowest beams were transverse, that is at right angles to the direction in which the house was to be moved.

TRUCK TOWING A 75-TON, NINE-ROOM DWELLING
Speed of 2 miles per hour was attained. No block and tackle was used, the load being moved by direct pull. Truck carried 8-ton ballast load.

A single four-wheel dolley was put under the center of the forward transverse beam and two dolleys were placed under the rear beam, one near either end. This arrangement gave sufficient stability and afforded the necessary flexibility in "steering." The dolley wheels were about 14 in. in diameter and had 14-in. tires.

The direct pull from the truck was transmitted to the house by a 1¼-in. steel drilling cable. The midpoint of the cable was passed through a pintle hook on the truck and at either end the cable terminated in chains that were passed under the lowest or transverse timber and thence around the forward ends of the longitudinal timbers.

The moving job was completed without any serious damage to plastering or plumbing, the actual moving

time being about two hours. One hour of this time, during the afternoon, brought the house to the point beyond which the permit did not allow it to move in the day time. After 8 p.m. the moving was completed in another hour.

Tunnel for Water Mains Under Cemeteries

AN 8½-ft. circular 4-ring brick tunnel (necessitated by the inability to resort to open-trench excavation) 2,200 ft. long, carries a 48-in. hammer-welded steel main under two cemeteries in Detroit, Mich. The depth is 43 ft. at one end and 57 ft. at the other. The 10½-ft. 4-ring brick shafts were sunk by building up a section of masonry work and mucking out the dirt inside. No cutting shields were used. The mucking in the tunnel was carried out by hand with the aid of a tunneling knife pulled by an electric motor. With 28 men the contractor, Booth & Flinn, Ltd., Pittsburgh, averaged 12 ft.

TUNNEL FOR 4-FT. BUMP JOINT STEEL PIPE
Hammer-welded pipe of ½-in. sheets has expansion joints at each end of 8½-ft. tunnel section, 2,200 ft. apart. Pipe rests on I-beams, providing water channel in invert of tunnel.

per day. Pipe was delivered in 20-ft. sections and all brought in from one end. It was laid on steel I-beams spaced on 5-ft. centers, with an expansion joint at each end.

An automatic electrically-driven pump located in the sump in the deeper shaft kept the tunnel dry. When the water in the sump raised the float to a predetermined elevation, the pump started to operate and continued until the sump was dry. If this float did not work, or if there was a leak in the pipe line which exceeded the capacity of the pump, the water raised a second float which rang an alarm bell in the central storage yard. A blow-off, to be used for draining the line, was installed in the deeper shaft.

Special cast-steel base-elbows were used at the bottoms of the shafts, while standard elbows were used at the tops. The pipe was anchored in concrete outside each shaft and also in the middle of the tunnel.

Manholes were placed at 700-ft. intervals. Single bump riveted joints were used on the circular seams. The type of joint used greatly facilitated the laying of the pipe according to the latest annual report of George H. Fenkell, superintendent and general manager. At first an open fire forge was used but the smoke and fumes were so dense that an electric rivet heater was substituted with excellent results. All joints were calked and the completed line, tested under 100-lb. head, showed no leaks or sweats at the beams. Of the 6,900 rivets driven only seven showed a slight sweating and were immediately calked.

From Job and Office

Hints that Cut Cost and Time

Coal Consumption Recorder Used at Philadelphia Water-Works

By H. R. Cady
Mechanical Engineer, Bureau of Water, Philadelphia, Pa.

FUEL being the largest item of operating expense in the boiler room careful and economical operation requires a frequent and reasonably careful check of the quantity consumed. With fuel oil the problem is of course extremely simple since we have a liquid in a regular shaped container and need only an elevation gage and calibration curve or table for the tank. In small hand-fired plants the coal consumed can usually be conveniently checked by means of scales over which the coal passes in push-cars or wheel-barrows.

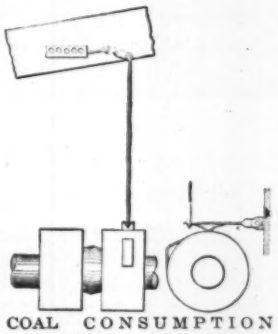
Large modern plants, however, where economy requires the use of mechanical stokers and mechanical coal-handling equipment, present a more difficult problem. Weigh lorries are used in many cases but they preclude the use of direct down-spouts, which are so desirable on account of the small amount of labor and freedom from mechanical complication and troubles. A coal meter for measuring flow through down-spouts has been in use for some time, but it is a rather expensive piece of apparatus and can not be expected to have a long life under the severe conditions encountered in boiler rooms.

The method of checking coal consumption which has been used in the Philadelphia Bureau of Water for some years, in connection with traveling grate stokers, consists of a counter attached to the driving shaft of each stoker, the counter readings being multiplied by a factor to take into account travel of grate per revolution of shaft, width of stoker, weight of coal per cubic foot and fire thickness. All factors except the last two are constant for any particular stoker and the factor of weight per cubic foot varies only with the general character of the fuel. The constant may be determined experimentally by weighing the coal fed to the stoker hopper and reading the counter and fire depth; or the constant may be made up by calculating the volume of

From Job and Office

For Contractor and Engineer

coal passing into the furnace per turn of driving shaft, the only experimental data needed being a determination of the weight of coal per cubic foot.



COAL CONSUMPTION COUNTER ATTACHED TO STOKER

The illustration shows a convenient, durable and inexpensive method of attaching counters. Counters of rectangular shape, rugged construction and fair size should be used since the cost is small, in any case, and those of too light construction and small size are not sufficiently durable for satisfactory service.

Steel Transmission Towers Raised While the Line Was "Hot"

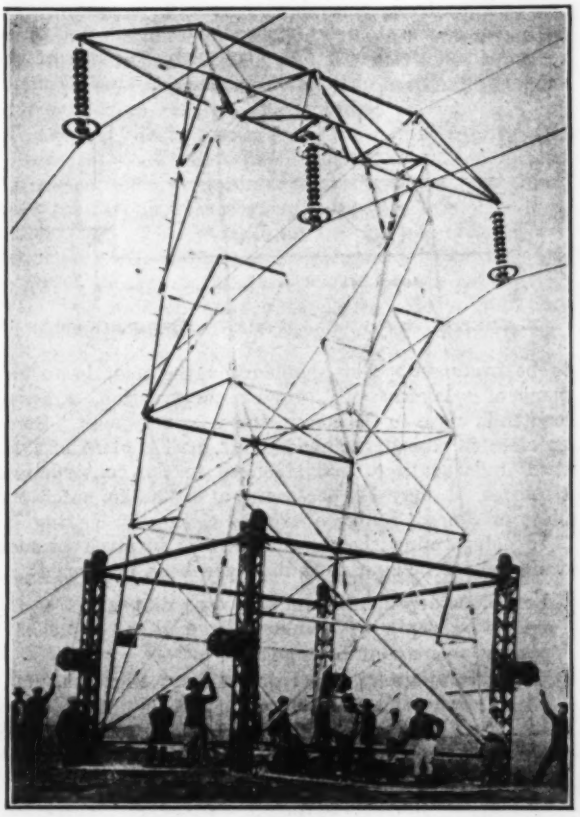
AS A PART of the program for increasing the voltage on a 240-mile transmission line from 150,000 volts to 220,000 volts, the Southern California Edison Co. found it necessary to increase the height of most of the steel towers over the entire length of the line in order to secure the desired minimum clearance of 30 ft. above ground for the cables carrying the current. Because of the importance of power transmitted over this line it was not feasible to keep it out of service while the process of raising the towers was under way; hence methods were devised for doing most of the work while the conductors were in service. The line was only "killed" for handling special cases, such as dead ends, sharp alignment changes, etc. Calculations showed that it would be safe to use vertical extensions of the tower legs and consequently the footing stubs already anchored in place. Although in some cases raises of as much as 20 ft. were made, the average raise was 10 ft.

The process of raising the towers consisted of lifting them bodily and holding them suspended while a structural steel extension of the desired height, which had been erected in advance, was placed and bolted. The device used for lifting the towers, shown in the accompanying illustration, consisted of four structural-steel latticed posts joined at the top by pipe struts which fitted into sockets and were held in place by kingpins. The ground was leveled off and wooden sills were placed to prevent any settling of these posts under load. A plate connection was bolted to each post and the adjacent footing. Steel cable guys with turnbuckles for tightening were used, extending from the top of each post to the bottom of the two adjacent posts, thus making diagonal bracing for the elevator. Each post carried a three-ton differential hoist for lifting. This was similar to a chain block, except that it had a drum instead of a load chain, and was mounted on a frame which was bolted to the post. The hoisting cable passed over a sheave in the top of the post to a plate clevis bolted onto the tower leg at the point where the connection was broken from the footing. A shoe bolted to the tower leg followed a vertical guide on the post.

Great care was used in keeping the towers plumb in raising so as to avoid any undue strains due to tilting. One tower leg and its elevator post were carefully grounded to the footings by heavy copper cables and broad terminals to avoid any possibility of accident due to the tower becoming energized.

The crew for this work was made up of four first-class towermen, four second-class towermen, four groundmen, truck driver and one foreman. The best record made was seven towers raised and bolted in ten hours, the elevators being left in place for the night on the last tower.

Before any raising was done, the ground wire was slacked off at its dead end points and the clamps at intervening points were loosened to permit slack to run through in order that there might be no abnormal



TOWER IN PROCESS OF BEING RAISED

As shown in this view, the weight of the tower is being carried by the elevator framework. At the post on the left the separation of the tower leg from its footing is seen.

strains set up in case a tower did not remain vertical while being raised. In the main power cables, however, there was sufficient slack so that the towers could be raised without changes. At points where ground-wire loads were unbalanced, such as at angle points, or where any particular conditions made the hazard more than normal, the line was de-energized before raising the tower.

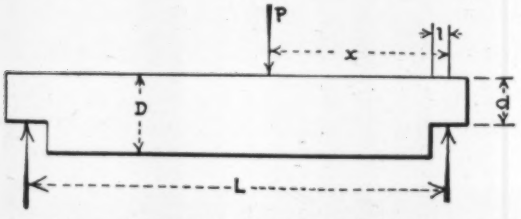
For about two-thirds of its length the transmission line is accessible by motor trucks, the remaining distance in mountainous country had to be reached by wagons or pack animals, and in some cases materials and equipment had to be transported to the site on men's backs.

Determining Longitudinal Shear in Wooden Beams

BY GEORGE A. MERRILL
Engineer with Desmond & Lord, Architects, Boston

IN BUILDING construction, the engineer or architect sometimes has cases wherein a wooden joist rests upon a wooden beam or some other support, and desires to notch the beam over the support that he may gain in the depth of floor, or may substitute deeper beams for shallower ones in order to gain strength; or it may be desired to cut out the joists in the under side to give room for a pipe. In determining the depth of shoulder, or the depth and distance out for the hole for the pipe, the strength of the joist in longitudinal shear must be considered in the one case, and the tensile strength in the other.

In general, such notching and cutting is not to be recommended; either a piece bolted to the side of the supporting girder or a shelf angle on a steel beam is



ELEMENTS INVOLVED IN SHEAR DETERMINATION

to be preferred. The shoulder on the joist is an element of weakness. If, during construction, a heavy load falls close to the notch, the joist may split. Some builders in case of notched joists, nail a piece of ¾-in. stuff underneath to add strength to the construction. However, it may be necessary at times to notch the piece or conceal a pipe above the ceiling by cutting in.

In determining the various factors involved in such design the following formulas have been developed:

Let D = depth of beam, in. (see diagram)
d = depth of shoulder, in.
L = span of beam, ft.
l = distance out from support of notch, ft.
W = total uniform load on beam
f = allowable transverse bending stress, lb. per sq.in.
f_1 = allowable stress in longitudinal shear, lb. per sq.in.
i = width of beam, in.

S = unit end shear $= \frac{W}{2}$ for uniform load

Then $BM = \frac{fD^2}{6} = \frac{WL12}{8}$

$W = \frac{fD^2}{9L}$ and $S = \frac{fD^2}{18L}$

$f_1 = \frac{SQ}{I}$, when Q = statical moment above its center of beam d deep; and I = moment of inertia of the same.

Then $f_1 = \frac{\frac{fD^2}{18L} \times \frac{d^2}{8}}{\frac{d^3}{12}} = \frac{fD^2}{12dL}$

$d = \frac{fD^2}{12Lf_1}$

From Job and Office

Hints that Cut Cost and Time

Following the Boston building law for yellow pine, $f = 1{,}600$ and $f_1 = 150$; for spruce, $f = 1{,}000$ and $f_1 = 100$.

Substituting these values,

for Y.P. $d = \frac{1{,}600\,D^2}{12\,L\,150} = \frac{8D^2}{9L}$

for spruce $= \frac{1{,}000\,D^2}{12\,L\,100} = \frac{5D^2}{6L}$

Longitudinal shear decreases as the support is left, while the bending moment increases. Therefore, the width of shoulder toward the center figured from the center of support, and the depth of any notching at points between the support and center of beam, depend upon the bending strength of the beam.

Then, the bending moment M, at a point l feet out from the support $\left(l < \frac{L}{2}\right)$ is, d being the depth of beam at this point,

$$M_1 = \frac{Wl}{2} - \frac{2l}{L}\frac{W}{2}\frac{l}{2} = \frac{Wl}{2}\left(1 - \frac{l}{L}\right)$$

where M_1 is in ft.-lb.

but $W = \frac{fD^2}{9L}$

and $M_1 = \frac{fD^2l}{18L}\left(1 - \frac{l}{L}\right)$

$\frac{12M_1}{f} = \frac{d^2}{6}$; $d^2 = \frac{72M_1}{f}$

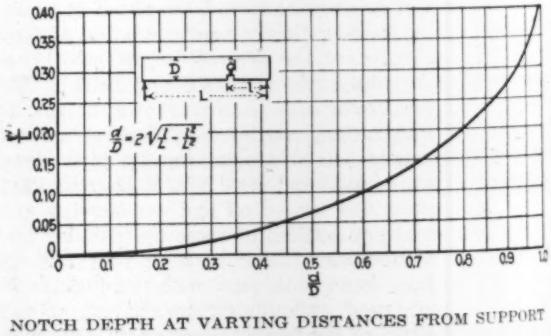
Substituting the value of M_1

$$d^2 = \frac{4D^2l}{L}\left(1 - \frac{l}{L}\right)$$

$$\frac{d^2}{D^2} = \frac{4l}{L}\left(1 - \frac{l}{L}\right)$$

$$\frac{d}{D} = 2\sqrt{\frac{l}{L} - \frac{l^2}{L^2}}$$

The diagrams show the minimum depth of shoulder d



NOTCH DEPTH AT VARYING DISTANCES FROM SUPPORT

for beams of D depth at center for various spans when subjected to the allowable bending stress; also the relation between $\frac{d}{D}$ and $\frac{l}{L}$.

For example a 12-in. spruce beam 16 ft. long, fully loaded, must not be notched more than 12 in. — 7½ in. or 4½ in.; $\frac{d}{D} = \frac{7\frac{1}{2}}{12} = 0.63$; and $\frac{l}{L} = 0.11$, $16 \times .11 =$

From Job and Office

For Contractor and Engineer

1.76 ft. or the shoulder, if 7½ in. deep, must not extend farther than 21 in. from the support.

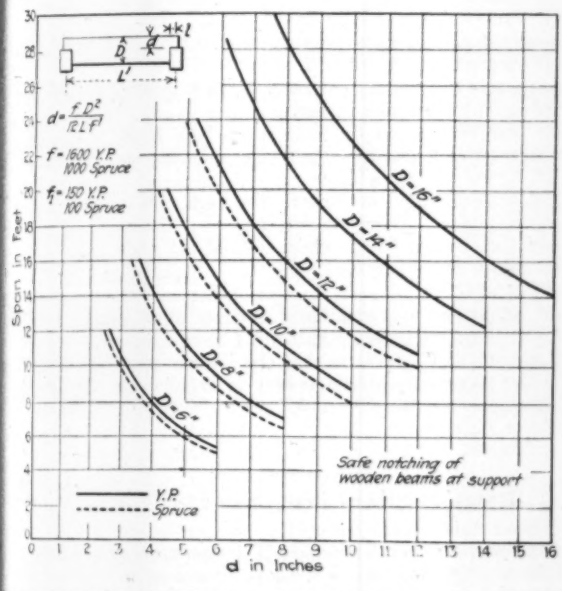
Suppose a notch is to be made in the beam 3 ft. out from the support:

Then

$\frac{l}{L} = \frac{3}{16} = 0.19$ and $\frac{d}{D}$ (by diagram) $= 0.78$.

$7.8 \times 12 = 9.36$, or the notch should be not over 2.64 in. deep.

The equations and diagrams are for uniform loading;



SAFE NOTCH DEPTH AT SUPPORT FOR VARYING BEAMS

for concentrated loadings, each case must be worked out individually.

In the figure herewith let beam L be loaded with load P x feet out $x < (L - x)$, then the maximum end reaction $= \frac{P(L-x)}{L}$.

Reaction per inch of width $\frac{P(L-x)}{tL} = S$, where t = thickness of beam in inches

$$f_1 = \frac{SQ}{I} = \frac{P(L-x)}{tL} \cdot \frac{3}{2d} = \frac{3P(L-x)}{2tdL}$$

$$d = \frac{3PL - 3Px}{2tf_1L}$$

for spruce $f_1 = 100$, and $d = \frac{3PL - 3Px}{200tL}$

If $P = 1{,}000$ lb. $x = 4$ ft., $L = 16$ ft.

$$d = \frac{36{,}000}{3{,}200t} = \frac{11.25}{t}$$

$$\frac{M}{f} = \frac{750 \times 4 \times 12}{1{,}000} = 36 = \frac{1}{6} tD^2 : tD^2 = 216$$

if $D = 10$ in., $t = 2.16$ in.

$d = \frac{11.25}{2.16} = 5.21$ = min. depth of shoulder in inches

$$M_1 = 750l = \frac{2.16(5.21)^2}{6} 1{,}000 = 9{,}770$$

$l = 13.06$ in.

In practice 3-in. x 10-in. spruce, or 2-in. x 12-in., would be used, and the cut could be made slightly deeper for the same distance out, or farther out for the same depth or cut.

Settling Tanks Clear Foundation Water

TO REMOVE the mud and sand from water pumped from foundation shafts and thus prevent clogging of the sewer into which this water was discharged, settling tanks were used recently in the construction of the Canal St. viaduct between Taylor and Harrison Sts., Chicago. In connection with the approaches to the new Union Station, part of Canal St. will be a reinforced-concrete viaduct with its columns supported by foundation piers built in open wells or so-called caissons sunk to rock. An unusual amount of water and water-bearing sand was encountered in some of the wells and this condition led to the use of the tanks.

The water was delivered from the pumps into a galvanized iron tank about 3x15 ft. and 3 ft. deep, fitted with wood baffles so arranged that the water rose from under the last baffle and overflowed into a similar but smaller tank. This latter was 4x6 ft., and 3 ft. deep, also fitted with baffles. The final overflow was led by the street gutters or by chutes to a convenient sewer inlet. Two pair of tanks were placed side by side, so that one pair could be cleaned while the other was in use. Each pair of tanks had to be cleaned several times daily. The contractor for this work is the Blome-Sinek Co., Chicago.

Dynamite Used to Excavate Soft Muck

TESTS were recently carried out in the Sugar Bowl Drainage District, near Pine Level, De Soto County, Fla., to determine the feasibility and costs of using dynamite for work through very soft muck. The tests were continued for two days. On the first day a 200-ft. strip was blasted, and on the second day two shots were fired, one covering a distance of 800 ft. and the other about 200 ft. In the first operation it was necessary to obtain a 5-ft. depth at the outlet of a dredged ditch, the work being complicated by the fact that for a distance of 50 ft. it was necessary to cut diagonally across the spoil bank of the dredged ditch. The spoil bank was 4 ft. high.

To get the 5-ft. depth for the entire distance four cartridges of 50 per cent straight dynamite were used in holes spaced 24 in. apart. In going through the spoil bank six cartridges were used to each hole and the load was gradually decreased to three cartridges as the depth of the ditch tapered to 3 ft. at the outlet.

The 800-ft. shot on the second day was a propagated shot; the 800 ft. of muck lifted in the air, split well and spread out widely on both sides of the ditch, leaving a clear ditch 3 to 4 ft. deep according to the grade that had been established and the depth of the holes, and 12 ft. wide at the top. This 800-ft. length was loaded with three cartridges of 50 per cent straight dynamite to the hole, with the exception of the last 100 ft., in which two cartridges were used, with one row of holes spaced 22 in. apart.

The total cost of the ditch, including labor, was less than 20c. per cubic yard. The work was done under the supervision of Otho O'B. Strayer, of the Du Pont Co.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Economy in Structural Steel

Sir—An editorial in your issue of April 12, p. 653, refers to the subject of steel economy. It is unquestionably true that economy in the use of materials is a necessary factor in engineering progress, and that the present high prices of all constructional materials make the question urgent. In the writer's opinion, higher stresses than 16,000 lb. per square inch are permissible in steel used in statically determined members of steel and reinforced-concrete structures. A stress of 18,000 lb. would not be too high.

European engineers are using stresses up to 21,000 lb. and higher in steel bridges, and in reinforcement of reinforced-concrete structures they are using stresses exceeding 17,000 lb., except that in bridges the reinforcement stresses are generally limited to 11,000 to 14,000 lb. However, it is important to bear in mind the fact that high working stresses are safe only when good material is used and the design calculations are precise and complete. The designer must take account of all contingencies and calculate the maximum stresses occurring in his structure.

Los Angeles, April 24. Z. GILLEWICZ.

Cemented Beds for Granite Blocks

Sir—In your issue of April 26, 1923, p. 760, a correspondent gives a clause proposed for his specifications for granite block paving.

A dry mortar bed has been used for wood and asphalt blocks for many years, but for granite blocks for only about ten years and then only in heavy traffic streets. In Manhattan it has been used as a standard since 1914, and this was probably its first use under granite blocks. The purpose was largely to prevent the washing away of the sand bed and the consequent settling of the pavement. The proper method is to mix the sand and cement to a uniform color and then spread the mixture, using it just as a sand bed would be used, and attention should be paid to obtaining a true surface on the concrete parallel to the finished surface of pavement.

The method of striking the bed is proper for a manufactured block such as wood or asphalt, but will not suit for granite, as it does not take into account the irregular depth of granite blocks, which necessarily vary at least ½ in. in depth.

R. A. MACGREGOR,
Assistant Engineer, Dept. of Public Works,
Borough of Manhattan.

New York, May 15, 1923.

Some Facts on Everglades Survey

Sir—In *Engineering News-Record*, April 19, p. 720, there appeared a letter by C. B. Burnside which, I fear, may be construed as a criticism of the operations of the Florida East Coast Ry. Inasmuch as I was connected with some similar work in the Everglades, I think my own experience may be of interest.

In 1915-17 I surveyed several townships, subdividing them into sections, of 640 acres each, a mile square, making 72 miles to the township and 60 miles of this was interior lines; each township consists of 36 sections, making a township six miles square. The work that I did was done under very favorable conditions. I employed a tractor such as was used by the railway in its surveying, and I used ten to twelve men. Mr. Burnside was a chainman on one of the surveys. I used five chain tapes, of a total of 350 ft. in length, and with a 4-ft. lath as a marker, we only had to stop for chaining each 350 ft. making only four stops in a quarter mile. In the open Everglades we averaged around ten to twelve miles per day—we have done as high as fifteen miles—but this was accomplished with three separate chaining crews. We had no hubs to set, no levels, no stakes to mark—except our quarter, half and three-quarter stakes and the section corner. This was all done in camp. The quarter, half and three-quarter stakes were 1x3-in. cypress, 5 ft. in length, which made them very light and handy to carry. The corner stakes were 1¼-in. galvanized pipe of 5 to 10 ft.

At the time of this survey, there was very little water on the surface of the ground in places and at times it was perfectly dry. I maneuvered my machine in such a way as to keep it in very close touch with my work and as to walking 20 miles, I don't know of any time that any of my men were ever required to do so in one day. We did walk, however, ten to twelve miles in doing some of this work, but we did not have from a foot to three feet of water to travel through, as the railroad engineers had on their trip from the North New River Canal to the Miami Canal the latter part of last summer.

In my chaining crews I employed three to four men. There was very little clearing, in fact nothing except an occasional high bunch of saw grass or weeds. Where there was any cutting to do, and where the above mentioned progress was made, the saw grass generally was from knee high to waist high, making progress generally good, as the head chainman had nothing to do except to walk ahead and keep on a line. There were spots encountered on and near Lake Okeechobee banks where we did not make more than one mile a day at times.

This work that I refer to was only a surveying contract and, of course, was conducted entirely different from that of a railroad engineering nature. I have been on both kinds of surveys and I am sure that the railway party made very excellent progress on the survey referred to in the article in *Engineering News-Record*.

OTIS A. HARDIN,
President, H. P. & W. Construction Co., Inc.

West Palm Beach, Fla.
May 24, 1923.

Bridge Members Lengthened by Welding?

Sir—I have been interested in reading in recent numbers of the *Engineering News-Record* the accounts of the repair of an old highway bridge by heating and upsetting certain structure members, and the controversy that has been started by them. I wonder if any of your readers have definite knowledge of an engineering feat that was performed in my home neighborhood, near Hudson, N. Y., years ago?

During the building of what was originally known as the Kinderhook & Hudson R.R., which I imagine to have been in the early '90s, it was common talk in the country side that the lower horizontal members of the iron bridge over Stockport Creek, at the first crossing north of Stottville, had been originally designed too short, or that the piers were built too far apart, and that the engineer in charge of the work had recruited a gang of local blacksmiths and welded into those members extensions to enable them to be used. Whether this story was true or not I cannot say, but I remember as a boy going swimming under that bridge and looking up at what were certainly rough and lumpy places on some of the structural members in question. The bridge was still there when I was last home, five years ago, although the old K & H has long since given way to a very up-to-date electric line that runs through to Albany. It might be interesting to either prove or disprove this story so long after its origin.

A. C. STOTT,
Commander, U. S. Navy.

Washington, May 12.

Joint Short Railway Authorized by I.C.C.

The Interstate Commerce Commission has authorized the construction of a joint line by the New York Central, the New York, Chicago and St. Louis, the Pennsylvania, and the Wabash. The new line which will be located in Allen County, Ind., will be only 8,000 ft. long and will be known as the Fort Wayne Union Ry.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Building permits issued in St. Louis in May, 1923, exceeded all previous figures, with a total valuation of $4,166,386 as compared with $2,396,880 for May, 1922.

Request that the Name of Harding Dam be given to the big reservoir project to be built on the Snake River near American Falls, Idaho, has been made by the residents of Pocatello, Idaho. The work on the project is under way.

Net Income for 1922 of $32,339,723 or $12.75 a share on its outstanding common stock is reported by the Union Pacific. In 1921 its income amounted to $11.73 a share. The company has written off as a complete loss the $15,259,531 which it invested in the securities of the Chicago & Alton R.R.

Competition of Motor With Rail traffic between Spokane and Seattle has come to a head in the filing of a joint suit by the Great Northern and the Chicago, Milwaukee & St. Paul to prevent the department of public works from issuing a certificate of necessity for the operation of an auto stage line between those cities. The auto stage line is now in operation between Spokane and Almira.

Contract for the Installation of automatic train control on 165 miles of double track between Blue Island and Rock Island, Ill., has been let by the Chicago, Rock Island & Pacific to the Regan Safety Device Co. of New York. This territory includes 216 automatic block signals, 4 mechanical and 2 power interlocking plants. There will be 240 ramps installed. 100 locomotives will be equipped for operation over this section of track.

Training For Prospective City Managers and other public administrative officials is being offered by the National Institute of Public Administration of New York (261 Broadway) in the form of special courses for engineers and other technically trained men who wish to go into the details of public-works, health, police and fire department administration, purchasing, various aspects of municipal finance, and personnel management.

Presentation of the Charles A. Coffin Foundation gold medal was made June 7 to the Southern California Edison Co., Los Angeles. This medal was offered for the first time last year to the electric public utility company of the United States which made the most notable contribution during the year to the development of electric light and power service, and this is the first award to be made by the Foundation, which was created by the General Electric Co.

Fire Destroys Broad St. Station Trainshed

Philadelphia Terminal of Pennsylvania R.R. Scene of Conflagration Which Wrecks Large Arch and Menaces Station

Special Correspondence

Fire starting at about 1 a.m. June 11 and continuing well over 12 hours practically destroyed the trainshed of the Broad St. Station of the Pennsylvania R.R. at Philadelphia, together with rolling stock and parts of the station itself. The total damage is estimated at between $1,000,000 and $1,500,000. For a time the station proper and the adjacent City Hall were menaced but they were saved from any but minor damage. Flying sparks, however, did jump Market St. to the south of the station and set fire to wooden formwork under concrete floors of a theater under construction at the corner of 16th and Market. These forms were destroyed from the sixth to the thirteenth floors. No lives were lost but many firemen were endangered by smoke and falling debris and several hundred occupants of sleeping cars under the shed were imperiled until the cars could be drawn out to safety.

The train level at the Broad St. station is on an elevated structure which crosses the streets by masonry arch spans. The 16 tracks are carried on plate girders, while the platforms between pairs of tracks are entirely of wood construction, being timber planking about 2 in. thick laid on what would appear to be 3 x 12-in. joists carried on steel over the girders. The trainshed is a single arch spanning all 16 tracks and resting on masonry walls on Filbert St. to the north and Market St. to the south. The shed was built in 1892 supplanting at that time a lower four-arch shed built in 1881.

The trainshed was described in *Engineering News*, June 1, 1893, p. 507. It is of wrought iron, with the exception of the lower chord bars which are of open-hearth steel. It consists of 10 main three-hinged arches each 300 ft. 8 in. c. to c. of end pins and with a rise of 108½ ft. Each arch is formed by a pair of parallel trusses, 9 ft. apart, the ribs themselves being spaced variously from 56 to 67 ft. apart. The whole shed is 598 ft. long. The roof was a combination of glass, sheet iron and wood.

Origin of Fire

The fire apparently started in the timber floor construction beneath the tracks and above the service rooms used for mail, baggage, storage, etc., and due to the oil-soaked condition of the timber, helped out by an explosion of a gasoline tank near the tracks, soon spread to practically all parts of the structure and down into baggage rooms and storage rooms below.

The slowness of its eventual spread and the difficulty of extinguishing it were apparently due to the fact that the track girders separated the structure into so many separate bays. This floor construction runs back toward the waiting rooms and main station building some 20 ft. beyond the train gates, and this part of the floor up to the bumpers was covered with 2 in. asphalt paving, which had to be ripped up by

Major Bell Succeeds Col. Keller in Washington Post

Major J. Franklin Bell has been appointed engineer commissioner for the District of Columbia to succeed Col. Charles Keller, who resigned to become associated with H. M. Byllesby & Co. in hydro-electric development on the coast. Major Bell at present is district engineer at Pittsburgh. He was appointed to the military academy from Pennsylvania, graduating in 1902. He is also a graduate of Washington and Jefferson College, receiving a B.S. degree in 1898 and his M.S. degree in 1907 from that institution. During the World War, Major Bell commanded the 24th Engineer Regiment, the depot at Angers and served with the first and second armies. After the armistice he assisted in the liquidation of surplus supplies and was chief engineer of the A.E.F. Nov. 10, 1919, to Jan. 8, 1920.

Heavy Rains Damage Kansas

Heavy rains in southern Kansas and northern Oklahoma, which swelled the Arkansas and tributary rivers to flood stage, have caused millions of dollars worth of property damage. Wichita has been particularly affected, the city being inundated, railway trackage in some places reported to have been covered to a depth of 10 ft. Railway service has been generally disrupted.

S. W. Stratton Inaugurated as President of M.I.T.

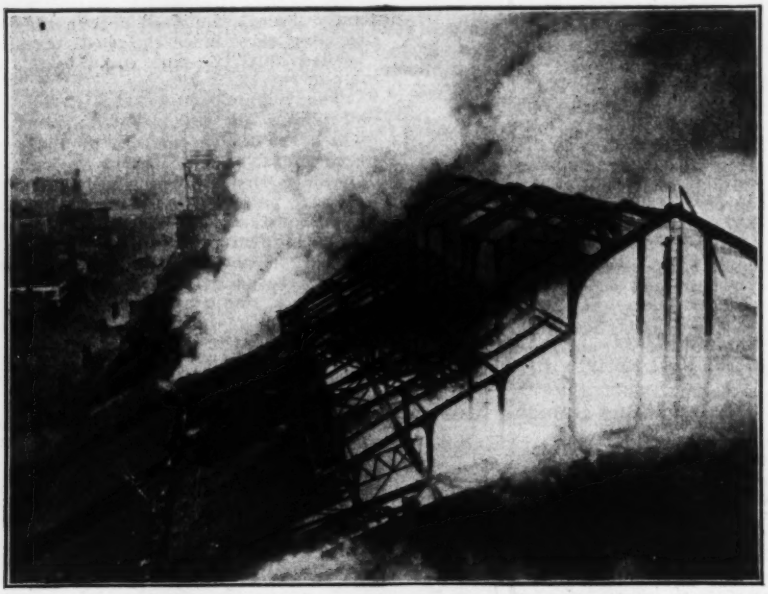
On June 11, Dr. S. W. Stratton, former director of the Bureau of Standards, was inaugurated as president of the Massachusetts Institute of Technology. The ceremonies were marked by an address of greeting from Governor Cox for the state and from Major-General George Owen Squier, for the federal government. Other speakers welcoming Dr. Stratton were Prof. Edward Furber Miller, representing the faculty; Dr. C. W. Eliot, representing the Founders of the Institute; Prof. C. E. A. Winslow, representing the alumni; and President John C. Merriam of the Carnegie Institution of Washington.

President Stratton based his inaugural address upon the part played by science in the evolution of industry, stressing the tremendous opportunities for industrial as well as social service open to those technically trained.

gangs of laborers in order to get at the smouldering fire beneath.

Such inspection as was possible up to the time this edition went to press showed that the steel roof structure was still standing intact, although individual arch and truss members had been considerably twisted by the heat. The wooden roofing has been almost entirely burned away leaving fragments of the sheet iron "protection" still hanging to the steelwork, and the glass which formed a large part of the roof covering has entirely gone. The track girders in the main held up the few cars and engines which had not been pulled out of the shed, although in one case they gave way and let their burden fall through.

The engineering department of the railroad is not yet ready to state the extent of damage but it is safe to say, however, that most of the steelwork of both floor and roof is now fit only for scrap owing to the intense heat treatment to which it has been subjected. The intensity of the heat during the early stages of the fire is shown by the warped surfaces of those of the steel cars which were in that part of the shed.



TRAINSHED OF BROAD ST. STATION, PHILADELPHIA
Photograph, by Underwood and Underwood, taken at 4 A. M., June 11

The estimated loss runs over a million dollars including the train shed, power plant and miscellaneous supplies and machinery, while the loss due to baggage destroyed may be even greater.

The running of trains was kept up surprisingly well, the train being made up as usual in the yards, not backing into the terminal, but being run empty to the West Philadelphia station where all passengers embarked. This small station was rapidly equipped with extra ticket offices, telephone booths, and so forth. Some detouring to avoid congestion was done, such as running all Atlantic City trains from Camden instead of starting some from Broad St., and having all trains from the West to New York run direct through North Philadelphia instead of pulling some in and out of the Broad St. station as formerly.

A.G.C. Chapters Dissatisfied With 3-Per Cent Alien Law

Reports received by the Associated General Contractors from member chapters on discussion of a national immigration policy, which was the topic suggested for consideration at all May meetings, indicate widespread dissatisfaction with the present 3-per cent quota law and a desire for a law based on selection, flexible as to numbers of aliens admitted. It will be some time before all reports are received.

It is the desire of officers of the Associated General Contractors to have the construction industry prepared to present definite views supported by concrete arguments to the committees of Congress which will consider permanent immigration legislation at the next session, as the existing law expires June 30, 1924. The discussion of this subject which all chapters were requested to assign for their May meetings is the first step toward defining a common policy for the industry.

Chapters meeting in June have been asked to discuss co-operation between the constructor and the designer, with emphasis on the responsibility each should assume toward the project.

New England Water-Works Annual Outing

The annual outing of the New England Water-Works Association will be held on June 20. The party will assemble at Washington Square, Worcester, Mass., at 9:45 a.m. and proceed by automobile to Pine Hill Reservoir, one of the nine reservoirs of the Worcester water-works system. Luncheon will be served at 1 p.m. at Sunset Hill Farm in Paxton, after which there will be an opportunity for baseball and other sports. All who can do so are requested to arrive at the assembly point in their own automobiles. The cost per person of the outing after arriving at the assembly point will be $2.50. The committee in charge of the outing is headed by George W. Batchelder.

Moffat Tunnel Bond-Issue Project Held Legal

Decision on the Moffat tunnel case, rendered by the U. S. Supreme Court last week, holds that the plan of paying for the work by a bond issue as proposed by Colorado is legal. The work is now expected to proceed without further delay. The litigation is referred to in Engineering News-Record, Nov. 23, 1922, p. 905, and a general outline of the project in the issue of Sept. 28, 1922, p. 532.

Runaway Car Does Great Damage to Brick Building

A street car on the Amsterdam Ave. hill in New York, on June 7, starting from near the top of the hill, ran backwards, for seven blocks to the foot of the hill, derailed at the turn into La Salle St. and collided with the building on the northwest corner of Amsterdam Ave. and La Salle St. The building was a five-story apartment house with a store on the ground floor. The store had show windows across the Amsterdam Ave. front and one window around the corner in La Salle St. The outer wall of the building above these windows was carried on steel I-beams supported at the corner on a cast-iron column. The car struck this column, knocking it from its footing, ran on past the front of the building and stopped on the sidewalk in front of the adjoining store. In the next instant the whole corner and front wall of the building up to the fourth floor collapsed and fell onto the sidewalk behind the car. The forward end of the floor of the second story front room was carried down with the wall. The floors of the other rooms remained in place. Two women who remained on the car and two other women who jumped from the car sustained minor injuries. The motorman also jumped but was uninjured. A child who had just come out of one of the stores was struck by the car and killed.

The motorman of the wrecked car states that the power gave out just as he reached the top of the hill, that he tried to apply the air brake but found that it would not work, nor could he work the hand brake. The car was one of the old one-man cars.

Suit Verdict Allows Completion of Pacific Highway

Construction of the last link in the Pacific Highway in Oregon which will allow continuous travel from Canada to Mexico is made possible in a recent court decision rendered by the Supreme Court of Oregon, upholding the opinion of the Marion County Court that the state highway commission and engineers are not bound to locate a highway on the exact line as called for in the highway act, in order that appropriations for such highway be made. The contention of the appellants in the case was that the line as located should pass through the cities of Dallas and Independence. The commission had selected that route as tentative and upon the original location was an appropriation for construction made.

New York Public Works Law Arousing Interest

Departmental Consolidation Experiment Will Depend for Success on Bureaus' Co-operation

Special Correspondence

The new Public Works Law of New York State, signed recently by Governor Smith, is an experiment in departmental consolidation. The success of the experiment will depend largely upon the spirit of co-operation expressed by various bureau heads. It was introduced as an administration measure and affects three principal departments, the highway, public buildings and public works, which are already Democratic as to their administration, so that the administration has taken nothing away from the Republican party in the consolidation. It has, however, created a vehicle whose functions will be subservient to and coterminous with the office of the Governor of the State. Thus a governor, representing a minority party, would have this consolidated department absolutely under control.

FUNCTIONS OF OFFICE

The superintendency of public works is a constitutional office. Section three of article five of the New York State Constitution provides:

"A Superintendent of Public Works shall be appointed by the Governor, by and with the advice and consent of the Senate, and hold his office until the end of the term of the Governor by whom he was nominated, and until his successor is appointed and qualified. He shall receive a compensation to be fixed by law . . . He may be suspended or removed from office by the Governor, whenever, in his judgment, the public interest shall so require; but in case of the removal of such Superintendent of Public Works from office, the Governor shall file with the secretary of state a statement of the cause of such removal, and shall report such removal and the cause thereof to the Legislature at its next session. . . . ."

It would appear therefore, under the terms of the new Public Works Law, that the present superintendent of public works would automatically become the head of the consolidated department on July 1; that if the Governor were to remove him and reappoint him to succeed himself, then the appointment for the balance of his term would be subject to confirmation by the Senate at the next session of the Legislature in 1924, and if he refused to be removed, a serious question of the right of the Governor to bring about his removal on charges might be raised. Section five of the new law, opening sentence, reads: "The state department of public works as now existing is hereby continued with the powers and duties now vested in such department and the additional powers and duties vested in it by this chapter." Section 11 of the law makes specific transfer of powers and duties to the present superintendent of public works, so that under the terms of the new law, as it reads, the present superintendent of public works is the superintendent of public works and has power to appoint his subordinates.

Whoever undertakes to effectuate the plan of consolidation will undertake a difficult task. If he wishes to effect real economy, he will be obliged to discharge a considerable number of recently appointed Democrats from positions; that is the only alternative, while the law itself creates a number of new positions. About the only feature consolidation which might be made is the merger of the three bureaus of bridges now in the state service.

It is also questionable if section nine of the law is not in conflict with the civil service provisions of the constitution and court decisions. It would seem to give arbitrary power for the appointment and removal of employees. Prior to 1894 the rule obtained that the civil service laws of the state did not and could not apply to appointments in the department of public works. That rule was abrogated, however, by the adoption in 1894 of section 9 of article 5 requiring that "appointments and promotions in the civil service of the state. . . . shall be made according to merit and fitness," and it is now well settled that departments in the department of public works are subject to the regulation of the general civil service laws of the state (Per O'Brien, J. in *People v. Roberts*, (1896) 148 N. Y. 360, 42 N. E. 1082, 31, L. R. A. 399, affirming 91 *Hun* 101, 34 N. Y. S. 641, 36 N. Y. S. 677).

The successful application of the new law will prove an object lesson to determine the advisability of the consolidation of other departments; its failure to function will constitute an indictment of the entire reorganization plan. Past experience demonstrates that departmental reorganizations seldom give shape to an administrative policy until after several months of functioning.

John D. Isaacs Retires

John D. Isaacs, consulting engineer of the Southern Pacific Ry. Co., retired from active service on June 1, 1923, after 48 years of engineering practice in the railway field. He was born at Richmond, Va., Oct. 6, 1848, was graduated from the University of Virginia, and on March 1, 1875, entered the service of the Southern Pacific as a draftsman. In 1890 he became acting superintendent of bridges and building and a year later assistant engineer, maintenance-of-way. In 1906 he was appointed consulting engineer for the Harriman lines, and in 1913 after the dissolution of the system he was retained as consulting engineer by the Southern Pacific. An appreciation of Mr. Isaacs was given in *Engineering News-Record*, April 15, 1920.

Highway Officials to Meet Dec. 3

The 1923 meeting of the American Association of State Highway officials will be held in New Orleans the week of December 3. A decision to that effect was reached last week by the executive committee which met in Washington. W. S. Keller, state highway commissioner for Alabama, was elected to succeed George P. Coleman, of Virginia, as chairman of the executive committee. Mr. Coleman had served for twelve years. J. D. Fauntleroy was elected a member of the executive committee.

Indianapolis Has Extensive Public Works Program

Sewers, Bridges and Viaducts, River Improvement, Street Work, Parks and City Planning Involved

The city of Indianapolis, Ind., has a large program of work to be done or started during 1923, under the direction of J. L. Elliott, city engineer. Among the projects are the following:

Sewers—On May 1 a contract was awarded for a sanitary sewer system for the north side, which will develop about six square miles of territory. Plans are being made for a new sewer system on the south side, to develop 20 square miles. Various sewer extensions will be made throughout the year as petitioned by property owners.

Bridges and Viaducts—On April 30 a contract was awarded to Todd & Reid for eight concrete arches over Pleasant Run and Pogues Run, under the jurisdiction of the Park Board, the total contract price being $141,000. Plans are being prepared for four concrete arch bridges across White River at Tenth St., Michigan St., Oliver Ave. and Kentucky Ave., in connection with the flood prevention program. These bridges will be from 600 to 900 ft. in length. Another bridge is being designed for Indiana Ave., over Fall Creek, which will be approximately 250 ft. long.

River Improvement—After the flood of 1913, the city constructed a levee on the west side of White River from 16th St. south to the Belt Railroad. War conditions prevented completion of the levee on the east side but plans have now been prepared for its construction.

Street Improvement—The 1923 session of the Legislature passed a law which permits the city to resurface existing streets, charging 75 per cent to owners of abutting property. This law carried with it a $300,000 bond issue for 1923. A total of $400,000 of work in accordance with this law is planned.

Parks—Bids have been invited for four ornamental comfort stations, built of brick and stucco. Bids have been called for on a $40,000 addition to the South Grove Golf House. Plans have been prepared for a wading pool in Military Park, an addition to the swimming pool in Willard Park, a new swimming pool in Rhodius Park and a natatorium in the southern district. A resolution has been adopted for the acquisition of 150 acres of wooded ground northeast of the city to form the nucleus of a new park. A resolution has also been adopted for the construction of another mile of the Pleasant Run Boulevard on the south side and a new boulevard in honor of the World War Soldiers on the north side, 10 to 15 miles in length. A contract has been awarded for paving five squares of Fall Creek Boulevard on the north side of the city with Kentucky rock asphalt and a resolution is now pending in court for the paving of eight squares of the same boulevard.

Track Elevation—Preliminary plans have been made for track elevation on the Union Belt R.R.

City Planning and Zoning—Under the zoning ordinance passed and made effective Dec. 15, 1922, the City Plan Commission is investigating traffic and main thoroughfares with a view to adopting a thoroughfare plan which will improve traffic conditions.

Random Lines

Some Suggested Openings in Rising to Discuss a Technical Paper—All Bearing the Approval of Long Usage.

——I do not know that I have anything to contribute to this discussion, but . . .

——The society is to be congratulated upon the opportunity of listening to so valuable a contribution . . .

——I regret that I have not had the opportunity of reading the paper, but in glancing over it just now there appear to be one or two points . . .

——The subject this evening is one of the greatest interest particularly that part . . . (here torture some sentence or phrase out of its context and lead from it gracefully into the speaker's pet hobby).

* * *

More Free Engineering

Won't some one in Chicago tell the author of this funereal-looking letter

Killem
A PESTICIDE
J.W. KAUFMAN COMPANY
MANUFACTURING CHEMISTS
CHICAGO, U.S.A.
Dear Sir:
You know nothing gives a Hotel, Hospital, Home Restaurant, or Business Building a BLACK EYE quicker than Rats, Mice, Roaches, Bugs etc. The person who sees or feels one never forgets and warns still they talk about it at your expense.
Did you ever stop to figure your losses every year by these pests?
If you have none of these pests we congratulate you.
But if you have, you need National Pesticide Service to end your pest trouble—It enable you to keep your place free from pests—to save those dollars wasted every year they smell but many losses caused by pests.
Don't put it off any longer, phone Dearborn 5892, now and we will send one of our expert exterminating engineers to start work at once.
At your service
THE NATIONAL PESTICIDE CO.
Service Dept. of
J. W. KAUFMAN CO.
J.W.K.-N.P.
FREE SERVICE
Our entomologists engineers will furnish information of any nature pertaining to vermin riddance for farm, home or business.
NO CHARGE - JUST PHONE DEARBORN 5892
ROACHES
MOTHS
BED-BUGS
ANTS
WATER-BUGS
FLEAS
FLIES
GUARANTEED
MONEY BACK GUARANTY

that free services are not being offered now by professional engineers?

* * *

A Dutch engineer reporting on a far-Eastern concrete bridge he had erected writes: "Cracks (shrinkage-cracks, as a consequence of hardening in the dry) have been stated only in the plaster layer up to now. The wildwooden centerings were namely of such a nature that plastering completely was necessary for the good aspect. In some places this plaster layer is even loose from the proper concrete, observed by means of knocking." Some of the friends of concrete sometimes feel that that is the way a lot of people observe concrete structures.

* * *

Higher Education

The new president of the Oklahoma Agricultural and Mechanical College has been escorted into office by state troops to protect him from the students, who don't like his politics or his personality. Why not introduce a pleasing innovation into the curriculum in the way of daily combat maneuvers between the President's bodyguard and the cadets of the Reserve Officers Training Corps.

Buffalo Gravel Firms Found Not Guilty

A jury in the New York Supreme Court has returned a verdict of not guilty in the cases of five firms and three individuals engaged in the sand and gravel business in and near Buffalo, indicted for alleged violation of the State Anti-Trust Laws. The indictments followed an investigation by the Lockwood committee here. The trial lasted eight days.

Over 300 Miles of N. Y. Railroad Affected by Electrification Bill

New York State Assembly Bill No. 1848, known as the Strauss-Kaufmann bill, calling for the electrification of all railroads within the limits of New York City, will affect about 311 miles of track. The law states that "No railroad corporation, operating a railroad within the limits of a city . . . having a population of one million or more, shall, on or after Jan. 1, 1926, use any motive power in the operation of such railroad or part thereof within the limits of such city, except electricity . . ."

To comply with this order it will be necessary for operating reasons, to electrify the whole of some divisions that are only partly within the city limits. On account of this fact the mileage affected is greater than the actual mileage of steam operated railroads within the city limits.

The mileage involved is as follows:

	Miles
Long Island R.R., main tracks and yards	123
New York Central:	
West Side, Manhattan Island main track and yards	88
Yonkers—main tracks and yards	6
Putnam Division tracks and yards	37
Port Morris Branch tracks and yards	12
Baltimore & Ohio yards	2
Staten Island Rapid Transit, main tracks and yards	23
New York, New Haven & Hartford	20
Total	311

Southern Pacific Builds $6,000,000 Line in Mexico

One hundred and three miles of new railway to give the Southern Pacific R.R. Co. access to Mexico City over the lines of the National Rys. of Mexico, are now under construction. The company is doing some of the lighter grading with its own forces and has recently let a $6,000,000 contract to the Utah Construction Co. for the other 90 miles. The location as now revised calls for a maximum curvature of a little over 9 deg. and a maximum grade of 1¼ per cent. There will be thirty-three tunnels with a total length of approximately 26,000 ft. and requiring 4,000,000 cu.yd. of excavation. Fourteen viaducts will have an aggregate length of 5,000 ft. and will require 5,500 tons of steel. The contract calls for the completion of the railroad in three years. Track laying and ballasting will be done by the company's own forces.

The new line will provide access by rail to the rich mining area near Ixtlan, State of Jalisco, and will open up an agricultural country devoted to the growing of garbanso and sugar cane. It will also provide a southern outlet for the states of Sonora, Sinaloa and Jalisco.

Don Pedro Dam Completed

Don Pedro Dam, built on the Tuolumne River in California to store water for the Turlock and Modesto irrigation districts jointly, has just been completed and will be dedicated on June 25, the second anniversary of ground breaking.

The spillway which has a capacity of 100,000 sec.-ft. has been equipped with ten gates, each 58 ft. long and weighing 22 tons, which sink into the lip when not in use and which can be raised to increase the reservoir height by 9 ft. The power house built at the toe of the dam is being equipped for an initial capacity of 15,000 hp. The dam is 1,040 ft. long on top, contains 282,000 cu.yd. of concrete and is 280 ft. nigh. The reservoir capacity is 280,000 acre-ft.

Sacramento Asks Bids on 150-Ton Garbage Incinerator

Bids for a 150-ton garbage incinerator are to be received by the city of Sacramento, Calif., until June 21. The incinerator is to be of the high-temperature, mechanically-charged type, capable of reducing garbage, refuse, and general municipal waste to clinker, and of affording complete combustion and of discharging chimney gases free from dust and objectionable odors. Bidders are to submit their plans, specifications and guaranteed estimate of cost of operation, together with references to other municipalities where U. S. furnaces of their make are used.

Civil Service Examinations

UNITED STATES

For the U. S. Civil Service examinations listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Highway Bridge Engineer—Vacancy in the Bureau of Public Roads, Department of Agriculture, for duty in the field, at $2,400 to $3,600 a year; and vacancies in positions requiring similar qualifications. Applications must be filed with the Civil Service Commission, Washington, D. C., before June 26, 1923.

CALIFORNIA

For the California State Civil Service examination listed below, apply to the California State Civil Service Commission, Sacramento or Los Angeles, Calif.

Associate Highway Engineer, Grade 5, and Highway Engineer, Grade 6, for service in the field under a division engineer, salary $285 to $350 per month. Applications must be filed with the California State Civil Service Commission, Sacramento, on or before June 23, 1923.

NEW YORK STATE

For the New York State Civil Service Examination listed below, apply to the New York State Civil Service Commission, Albany, N. Y., or to any local office of this New York Civil Service Commission.

Assistant Sanitary Engineer — Vacancy in the Division of Sanitation of the New York State Department of Health, for duty in the field on investigation and reports, salary $2,500 to $3,000 a year. Application must be filed with the New York Civil Service Commission on or before June 16.

Engineering Societies

Calendar

Annual Meetings

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Convention, Ithaca, N. Y., June 20-23.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York. Annual Convention, Chicago, July 11-13.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

The Pittsburgh, Pa., Section of the American Society of Civil Engineers at its annual meeting May 31 elected James L. deVou president, R. V. Porter, vice-president, and Nathan Schein secretary-treasurer. The retiring president, John N. Chester, gave an illustrated lecture on "Engineers Who Have Become Famous."

The Buffalo, N. Y., Engineering Society recently elected the following officers: Karr Parker, president; W. L. Spaulding, vice-president; N. L. Nussbaumer, secretary; and E. T. Mathewson, treasurer.

Personal Notes

MAJOR MAX C. TYLER, Corps of Engineers, U. S. Army, has been ordered to proceed to Florence, Ala., for duty as principal assistant to Lieut.-Col. George R. Spalding, in charge of the work on Muscle Shoals. It was the original intention to give Major Tyler charge of the Muscle Shoals work but because of ill health he asked to be relieved of the full responsibility which such an assignment would entail. Major Tyler will be succeeded as district engineer in Washington by Maj. James A. O'Connor.

The WEEKS CONSTRUCTION CO., Dayton, Ohio, has been organized with a capital of $50,000 to do a general construction business.

NORMAN F. BROWN and CHARLES M. REPPERT announce their association as BROWN & REPPERT, INC., engineers, with offices in the Commonwealth Bldg., Pittsburgh, Pa. Mr. Brown was formerly in charge of construction for the Pennsylvania R.R. in the Pittsburgh district, and after the war was director of public works in Pittsburgh and later vice-president of the Dravo Contracting Co. Mr. Reppert for a number of years was connected with the department of public works in Pittsburgh and was chief engineer of the Bureau of Engineering in 1921 and 1922; previous to which he was chief engineer and assistant manager of the Housing Division of the Emergency Fleet Corporation. Among the works undertaken in Pittsburgh under Mr. Brown as director of public works and Mr. Reppert as chief engineer were the construction of the Boulevard of the Allies, restoration of Bigelow Boulevard Slip, and improvements on other streets including Brownsville Ave., Broad St., and West Carson St.

EDWARD T. JONES, for the past four years chief engineer of the Stevens & Thompson Paper Co., has been appointed general manager of their mills at Middle Falls, N. Y. During the war, as lieutenant in France, Mr. Jones had charge of the Langres water supply.

THOMAS C. HIGGINS, formerly inspector with the Maine Highway Commission, has been appointed construction engineer of the Sanders Engineering Co. at Gorham, N. H.

CLAUDE V. TURNER has been appointed city manager of Bartow, Fla., to succeed J. W. Greer. Mr. Turner has been employed in Bartow on power plant projects in connection with the development of the phosphate industry in Polk County.

PETER C. HAMMELEF, formerly resident engineer with the Pennsylvania State Highway Department, has recently become associated with Connell, Laub and Bracht, road builders of Parkersburg, W. Va., as engineer.

FRED C. DUNLAP, for the past nine years chief of the Bureau of Surveys, Philadelphia, became chief of the Bureau of Water on June 1, succeeding Carleton E. Davis whose resignation was recently announced in these columns. Mr. Dunlap was formerly chief of the Bureau of Water, having entered the service of the Bureau in 1900 in a subordinate position. Subsequent to being chief of the Bureau of Water he held successively the positions of consulting mechanical engineer to the Bureau of Surveys; chief engineer, Department of City Transit; and chief, Bureau of Surveys. In view of the fact that Mr. Dunlap had previously held the office of Chief of the Bureau of Surveys, the Philadelphia Civil Service Commission, at the request of Frank Caven, director of public works, requested the Commission to waive examinations in the case of Mr. Dunlap as it had previously in the case of Mr. Davis. The alternative to waiving examination would have been what is known in Philadelphia as a "promotion examination" under which the only two persons eligible would have been Mr. Dunlap and Seth Van Loan, the latter having been for some time deputy chief of the Bureau of Water.

W. W. DALZELL was recently appointed city engineer of Iron Mountain, Mich. Mr. Dalzell was previously assistant engineer in the Bureau of Sewerage in the city of Akron, Ohio, in the design and investigation of intercepting sewers and sewage treatment.

R. D. SHORT has been made bridge engineer of the Kentucky Highway Department, having been previously employed in the same organization as a designer.

C. F. PRICE, formerly with the California State Highway Commission, has been appointed city manager of San Mateo, Calif.

HERBERT NUNN, former state highway engineer of Oregon, was appointed general manager and engineer of the Contractors Association of Northern California on June 4. As chief engineer of the Multnomah County (Ore.) system of highways and as state highway engineer of Oregon, Mr. Nunn has, during the past eight years, been in charge of the construction of the Oregon state highway system, including the Columbia River Highway. The membership of the contractors' association is composed principally of general contractors engaged in state, county and city highway and other heavy construction in Northern California. Its head office is in San Francisco.

JOHN R. FREEMAN of Providence, R. I., has been appointed consulting engineer for the city of San Diego, Calif., to investigate and advise the city council on the development of additional water supply in the San Diego river basin.

W. G. KNOX, city engineer of Santa Ana, Calif., has been appointed street superintendent in addition to his duties as city engineer.

C. C. CARLISLE, consulting engineer, Cheyenne, Wyo., has been appointed city engineer following the resignation of D. C. Showers.

JAMES R. POLLOCK, assistant city engineer at Lansing, Mich., has returned to Flint, Mich., to resume work in the city engineer's office of investigating the sewage disposal problem in the latter city.

STEVENS & KOON, consulting engineers, Portland, Ore., have been appointed valuation engineers for the Pacific Power & Light Co. of Portland, Ore.

JOSEPH JACOBS, of Powell & Jacobs, consulting engineers of Seattle, Wash., has been appointed to represent the city of North Yakima, Wash., to make an appraisal of the water-works of that city with a view to the city's taking over the water-works.

ADAM SCHWINN has been appointed assistant city engineer of Dayton, Ohio, to succeed W. C. Wangler, resigned. Mr. Schwinn had been employed many years in the Dayton office.

Obituary

WALTER J. HARRINGTON, a concrete construction engineer, died in Brooklyn, New York, June 6, of pneumonia, at the age of 36 years.

CHARLES SIRRINE, for thirty-five years in the construction business in New York City, died June 7 aged 52 years. Mr. Sirrine had been associated with the Alfred Boote and Frank L. Davis companies.

ARNOLD R. DOE, East Haddam, Conn., superintendent of bridges under the state highway department, died May 24 while submerged in a diving suit in the Connecticut River. In inspecting the piers of the East Haddam bridge, Mr. Doe in diving suit was first successfully submerged for five minutes at a depth of 25 feet and pulled up. He then asked to be submerged the full depth of 40 ft., and the men on the barge, not receiving a signal from Mr. Doe after fifteen minutes, brought him to the surface and on opening the suit, which however had no water in it, found him dead—physicians said from heart failure. The bridge was being inspected to show that there is no danger of collapse.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Practical Hints on Wood Pipe Construction

Manufacturer Suggests Details of Best Practice in Use of Continuous Stave and Wire-Wound Pipe

TO INSURE the best service from wood pipe of both the continuous stave and wire-wound types, the Continental Pipe Manufacturing Co., Seattle, has incorporated in a newly published handbook and catalog a number of practical suggestions covering details of construction and maintenance. The following notes cover the main points:

While wood pipe can be laid by inexperienced workers if they follow the directions which come with the pipe it is usually best to employ experienced men, constantly doing work of this character, who are kept on the payroll of the manufacturing company to be sent out on work on a per diem basis. Pipe should be unloaded carefully from cars so that the tenon or mortise ends will not be broken or wires or surfaces of the pipe injured. The laying of wood pipe requires care and precision, and joints must be driven snugly home without abusing the pipe in the process.

Laying Pipe

Wood pipe for all purposes, when untreated, should be either completely buried in non-porous soil or left completely exposed resting on supports clear of the ground. Especially with the larger sizes of pipe wooden or concrete cradles should be employed. With an exposed pipe repairs can be quickly made and leaks readily detected. Where silt is encountered in lines blow-offs should be used, so that accumulations may be readily removed.

The pipes, if buried, should be well covered with material free from vegetable matter which rots and leaves the ditch porous to surface waters and the atmosphere. Too little attention is given to backfilling the pipe trench. Rocks should not be left under the pipe nor packed against it. A finer material should be used under and about the bottom of the pipe than at the sides and top and should be well compacted either by hand or by puddling with water.

Uncreosoted pipe should either be kept entirely above ground or placed well below the surface and backfilled. An alternate wet and dry condition is exceedingly detrimental and has been the cause of nearly all complaints regarding wood pipe lines. This condition cannot always be avoided and in such instances the pipe manufacturer recommends the use of creosoted staves.

Pipe Line on Curves

In the location of wood-stave pipe lines it is preferable to provide fairly sharp curves and long tangents, instead of easy curves and short tangents. The accompanying table indicates safe radii of curvature for different diameters of continuous stave pipe.

The practice is recommended of dropping the grade of the pipe as quickly as possible from the intake to a point 25 to 50 ft. below the hydraulic gradient, so that the pipe may always be kept full of water and the staves at the top as well as the bottom become saturated. In localities where the upper end of the pipe line cannot be maintained under pressure the upper end of the line may be made of creosoted material while the lower end may economically be laid with untreated pipe.

SAFE RADII IN FEET FOR CONTINUOUS STAVE PIPE

Diam. ft.	Thin Shell	Thick Shell
2	100	115
3	115	125
4	125	150
5	150	175
6	200	225
7	275	300
8	350	400
9	450	500
10	...	600
11	...	650
12	...	700
13	...	775
14	...	850

In placing air valves it should be kept in mind that the greatest accumulation of air is not necessarily at the extreme high point, as the velocity of water may carry the air beyond the summit a short distance, depending upon the grade of the pipe. An air vent should be placed at points where the pipe drops with increased gradient, so that in cases of heavy draft, a vacuum will not cause the collapse of the pipe.

In dredging or sluicing operations wood pipe, when worn on the bottom, may be turned one-quarter way and each pipe section used four times. For carrying heavy sluiced materials there is provided a special type of spoil pipe with a bottom made of removable wood blocks, which can be replaced when worn.

Sales Managers to Organize on National Scale

At a recent meeting held at the New York Advertising Club by a committee representing the New York Sales Managers' Club and the Sales Managers' Clubs of Philadelphia, Boston, St. Louis, Milwaukee, St. Paul and Columbus, it was decided to organize the National Association of Sales Managers, the first meeting to be held at Atlantic City, June 7, directly following the convention of the Associated Advertising Clubs of the World. Membership in the Association will be confined to sales managers, either as individuals or as a club membership.

The object of the association is, through co-operation, investigations and systematic interchange of ideas, to secure for members the benefits of the best and most economical methods in the sale, marketing and distribution of merchandise. Charles F. Abbott, 26 Madison Ave., Montclair, N. J., was elected chairman of the forthcoming meeting. Sales Managers throughout the country are cordially invited to attend the first conference and further information may be obtained by addressing the Chairman.

Railways and Shippers Organize Regional Advisory Boards

For the purpose of bringing about the fullest measure of co-operation between the shippers and the railroads of the country, to give the shipping public a direct voice in the activities of the Car Service Division on all matters of common interest, regional advisory boards, composed entirely of shippers and selected by the shipping public itself, are being organized in various parts of the country by the American Railway Association. These boards will work in conjunction with the district manager of the Car Service Division, together with representatives of the railroads in the various districts. Regional advisory boards have already been organized in five districts.

Trade Report on British and Dutch East Indies

The Department of Commerce has just released a new report (Special Agents Series 218) in its series of Commercial and Industrial Handbooks, entitled "Netherlands East Indies and British Malaya," by Trade Commissioner Fowler. The book, a work of 411 pages, the result of Mr. Fowler's three years residence as trade commissioner to the Netherlands East Indies and British Malaya, goes into detail on the mineral resources and the industrial and agricultural development of the territory under review. He presents a thorough study of the dominant industries, gives detailed statistics on imports and exports of primary products, reviews the import needs, gages the future prospects and offers suggestions to American business men who wish to launch their products in these fields.

Our direct trade with these sections of the Far East now averages more than $300,000,000 annually and Mr. Fowler is optimistic as to future expansion. The book costs $1 and may be obtained from the Superintendent of Documents, Government Printing office, Washington, D. C.

Study Effect of Immigration Cut on Industry

Immigration statistics for 1922 with relation to the 3 per cent restriction law, while showing that "unquestionably the law greatly reduced the volume of immigration," do not afford a certain basis for estimating the future effect of the act on the industrial labor situation, according to a recent report of the Civic Development Department of the Chamber of Commerce of the United States. The survey was the basis of the report of the Immigration Committee of the National Chamber, recently made public, and which recommended retention of the 3 per cent restrictions, coupled with an additional 2 per cent quota allowance in case of demonstrated need to be employed in making a practical test of selective restriction methods. Action by the National Chamber on the committee report is expected during the annual meeting of that body in New York this month. The survey showed that in 1922 (fiscal year), the first year in which the 3 per cent law was operative, excess of aliens admitted over aliens departed was 87,121 as compared to 552,132 in 1921 and 769,276 for the last comparable pre-war year, 1914.

Highest Court Holds Price Interchange Unlawful

American Linseed Oil Co. Enjoined From Exchanging Trade Data, Reversing Lower Tribunal

Washington Correspondence

Manufacturers in the same industry cannot exchange information as to sales and prices practically as a unit controlling the business of the industry without coming into conflict with the Sherman law, even though the information be cleared and distributed by an independent agency, the United States Supreme Court held June 4 in a decision reversing the action of the District Court for Northern Illinois in holding for the defendants in the government's suit against the American Linseed Oil Co. and eleven other crushers, and the Armstrong Bureau of Related Industries. The opinion, read by Associate Justice McReynolds, directed the District Court to grant the government the injunction it had sought.

The twelve linseed oil manufacturers were subscribers to the Armstrong Bureau. They are alleged to have controlled a large part of the business of their industry. They agreed to turn over to the Bureau full reports of sales, quotations, offerings and other information. They were to receive through the bureau data on the market, trade and manufacturing conditions in the industry, economies in manufacture and sale, information regarding credit of buyers, uniform cost accounting systems, fair freight rates, standardization of products and other information and help.

The District Court held that this agreement was not unlawful and denied the government's petition for an injunction against the practice as a violation of the Sherman act.

Business Notes

SURPLUS STEEL EXCHANGE, INC., New York, has been formed to dispose of excess stocks of steel. A commission will be charged only on sales made, as the organization does not propose to purchase material but acts solely in the capacity of agent. The officers of the new company are Robert D. McCarter, president; George E. Dix, vice-president; William L. Cooper, treasurer, and Edward Michaud, secretary and general manager.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO., East Pittsburgh, Pa., announces the acquisition of the plant of the Savage Arms Corp. at Sharon, Pa., which will be remodeled and equipped for the manufacture of transformers. At the new works, which will be in operation in the fall, C. H. Champlain, formerly assistant works manager at East Pittsburgh, has been appointed works manager and M. L. Fawcett has been made superintendent.

GEORGE W. CRAIG, for ten years city engineer of Calgary, Alta., has been appointed district engineer for the Portland Cement Association with offices in Chicago.

MINE & SMELTER SUPPLY CO., with branches in Denver, Salt Lake City, and El Paso, has taken over exclusive representation for Colorado, Utah, Nevada, Wyoming, New Mexico, and western Texas of the plastic arc welders and color-tipt welding metals manufactured by the Wilson Welder & Metals Co., New York.

HARRISBURG MANUFACTURING & BOILER CO., Harrisburg, Pa., recently opened a sales office in the Park Row Building, New York City. The company builds boilers, tanks, steel stacks, breechings and entire lines of machinery for companies not having their own shops.

HOWARD E. BOARDMAN, for the past seven years engineering assistant to the general valuation counsel of the New York Central Lines, located in New York, recently resigned to become president and treasurer of Foster, Merriam & Co., Meriden, Conn., manufacturers of brass and grey iron castings and cabinet hardware.

WEBSTER MANUFACTURING CO., Chicago, announces further expansion of its Canadian business. A new corporation, the Webster-Inglis, Ltd., 14 Strachan Ave., Toronto, has been formed. The new plant will design and manufacture elevating, conveying and power transmission machinery along the same lines as now manufactured by the Webster company.

Equipment and Materials

Spring Scraper Truck Attachment for Road Maintenance

For the maintenance of earth and gravel roads a spring scraper blade attachment, designed to be bolted to the chassis of a motor truck, is manufactured by the Root Spring Scraper Co., Kalamazoo, Mich. The device employs the same principle as has been used by the company in the manufacture of its snow scrapers for street cars. The scrapers are manufactured in several sizes to suit any make or capacity of motor truck. For a truck of 1 ton or less capacity a four-spring scraper, 9 ft. long, is supplied. For a 2-ton truck,

the scraper length is increased 1 ft., and for trucks of over 2 tons capacity the 10-ft. length of blade is employed and the number of springs increased to five.

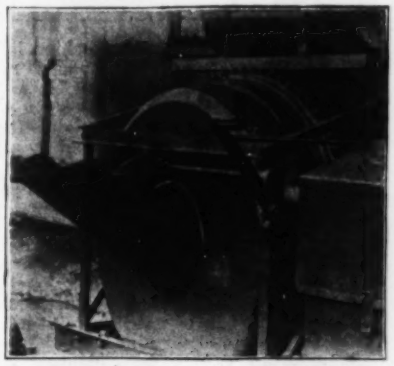
The blade is of high carbon spring steel 8 x ½ in., with an extra strip, oil-tempered, 3 x ½ in. on the lowest cutting edge. The strip is made so that when one edge is worn it can be turned over and the other edge used. The springs are 6 in. wide and ½ in. thick.

As shown in the accompanying photograph, the scraper is installed between the wheels of the truck on an angle of about 45 deg. across the body and is operated by a windlass double ratchet wheel and chain, running in a 12-in. sheave on the scraper shaft. The top of the hanger board is carried by brackets 21 in. above ground, which are in turn bolted to the truck frame. When not in use the scraper can be released and turned up underneath the truck.

With the scraper on earth or gravel road maintenance a truck speed of from 6 to 8 miles per hour is recommended, while for snow removal speeds of 15 miles an hour or more may be attained.

New Chute Mechanism for Concrete Mixer

For operating the discharge chute of its 7-S concrete mixer the T. L. Smith Co., Milwaukee, has developed a new mechanism. The operating lever is pivoted to a short arm keyed to the shaft to which the chute is attached. When the operating lever is moved a small roller, attached to the end of the lever, follows the outline of a cam bolted to the mixer frame. Except for the rod which extends across the mixer to enable the chute to be operated from



the other side, these few simple parts constitute the complete discharge operating mechanism.

In the illustration the lever is shown in its extreme forward position. The chute is locked securely in the position for mixing and interferes in no way with the mixing action. Pushing the lever back moves the chute into the discharging position. In the full discharge position the chute is locked and does not have to be held. The peculiar shape of the cam provides the locking feature in each position, no other arrangement being necessary. Releasing the chute from either position is merely a part of the operation of moving the chute from one position to the other. The operator simply moves the handle forward or backward, according to the position of the chute.

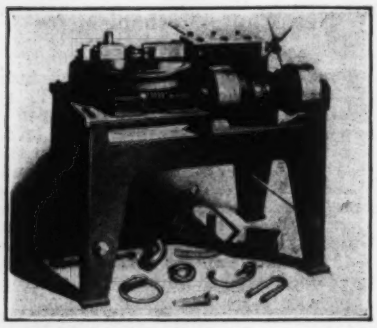
New Large Revolving Shovel

To meet a demand for a large revolving shovel for coal stripping, iron and copper mining and large construction projects the Bucyrus Co., South Milwaukee, Wis., is now offering a new shovel, known as the 320-B, which has superseded its 225-B revolving shovel. This new machine follows in the main the general features of the 225-B. It carries the same size standard dipper, 7½ cu.yd. capacity, heaped measure, but is equipped with an 85-ft. boom. The shipping weight has been increased from 560,000 lb. in the case of the 225-B to 625,000 lb. in the new machine. This added metal has been distributed in vital parts of the machine where the

greatest strains are imposed. A number of these machines have already been sold in various parts of this country.

Bar Bending Machine

For bending metal bars—rounds, squares, flats, tees, angles, and channels—the Wallace Supplies Manufacturing Co., Chicago, has placed upon the market a bending machine equipped with pulleys for belt drive. For cold



bending the capacity of the machine is 1 in. diameter squares or rounds, ⅝ x 2-in. flats, and 2 x 2 x ¼-in. angles.

The bending machine occupies a floor space of 3 x 4 ft. and is 3 ft. high. It weighs 950 lb. and may be driven by a 3-hp. motor. The speed of the rotating table is 6 r.p.m. A fair average production estimate for ordinary cold bending to 180 deg., the manufacturer states, is 150 pieces per hour based on rounds, squares, and flats bent flatwise.

The machine is started by a hand lever and there is an adjustable mechanism which stops the rotating table at any predetermined point so that materials can be bent identically to any desired number of degrees.

Publications from the Construction Industry

Transportation for Road Building—GENERAL MOTORS TRUCK CO., Pontiac, Mich., in a 16-p. booklet entitled "Money-Saving Transportation for Road Construction and Maintenance," shows a wide variety of the uses of its motor trucks on highway construction contracts. Among the subjects discussed are: Batch charging with motor trucks, in which advantages are claimed for the multiple-batch-body instead of the light one-ton truck carrying a single batch; motor trucks versus industrial railways; body equipment; loading and turning trucks.

Steel Forms for Concrete Floors—BLAW-KNOX CO., Pittsburgh, in a 12-p. illustrated bulletin, explains the use of its removable pan system for ribbed slab floors. The pans are steel soffits of No. 14 gage, no lumber being used, except in the shoring. The saving in lumber is one of the big economies claimed for the system of steel forms. The bulletin contains a double-page reproduction of a blueprint illustrating in details the various steps in setting up and removing the forms. The pans are furnished in depths of 6, 8, 10, and 12 in., are 6 ft. or 8 ft. long, and provide for 25 in. center to center of joists.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Production and Material Stocks in Ten Cities

Record Iron Output—Steel, Lumber, Cement Increasing—Fewer Burned Brick—Rail Shipments Better

Iron and Steel—Pig-iron output during May averaged 124,764 gross tons per day as against 118,324, for the preceding month. This rate represents the heaviest on record in the history of the industry.

Steel ingot production, according to the Iron and Steel Institute, totaled 3,537,753 tons during May as against 3,321,278, for the month preceding. The following table shows output in gross tons during the first five months of the current year as compared with the corresponding period in 1922:

	1923	1922
January	3,251,694	1,593,482
February	2,919,017	1,745,022
March	3,402,007	2,370,751
April	3,321,278	2,444,513
May	3,537,753	2,711,141

Unfilled steel tonnage figures issued by the U. S. Steel Corporation, totaled 6,981,351 tons, May 31, against 7,288,509, April 30 and 7,403,332, March 31, 1923.

Lumber—The National Lumber Trade Barometer, June 8, shows production at 5 per cent above normal; shipments, 106 per cent and orders, 82½ per cent of normal production. In other words the present situation is one of increased production and shipments with a falling off in demand. One year ago production was nearly 5 per cent below normal with shipments 100 per cent and orders 97½ per cent of normal production. The following table shows lumber movements this month, compared with last:

	Four Weeks Ending— June 2, M. Ft.	May 5, M. Ft.
Cut	1,102,856	1,036,778
Shipments	1,035,352	1,018,967
Orders	857,074	949,078

Cement—Stocks on hand throughout the entire country May 1, totaled 11,450,000 bbl. as aganist 14,470,000, for the corresponding period in 1922, according to the Geological Survey. Production during the first four months of the current year amounted to 36,991,000 bbl., against 24,497,000, for the corresponding period in 1922. Shipments from January to April, 1923, inclusive, totaled 34,625,000 bbl., compared with 21,810,000, during the first four months of last year.

Brick—Burned brick on hand totaled 150,316,000 as of May 1, compared with 181,298,000 for the month preceding, according to the Common Brick Manufacturers' Association of America. Orders on books increased 852,000 in one month. Demand has been more pronounced during the last thirty days in every district of the country except New York and New England, the Middle Atlantic states and the agricultural belt just west of the Mississippi. In Illinois and in eastern Pennsylvania and New Jersey demand has grown in volume from 200 per cent to 400 per cent.

San Francisco—Large reserves of road oils, asphalt and reinforcing bars. Supply of structural rivets, somewhat low a month ago, has improved. Shortage of cement threatened. Stocks low on blue annealed steel sheets. Other construction materials stocks in fairly good condition.

Los Angeles—Slight shortage of sewer pipe. About half enough cement in dealers' warehouses. Hollow tile demand strong but no shortage of material. Heavy lumber reserves at harbor. Steel mill shipments take two to three months. Ample supplies of other materials.

Denver—About 500,000 brick on hand; supply dropped to one half of last month's reserve. Mill deliveries of materials moving easier since settlement of strike difficulties.

Minneapolis—Cement, lime, brick, tile, etc., reported readily obtainable, though no great amounts are on hand

Freight Loadings Near Record

A total of 1,014,029 cars were loaded with revenue freight during the week ended on May 26, according to the Car Service Division of the American Railway Association. This total is not only by far the largest loading ever reported for any one week at this season of the year, but has only been surpassed twice before for any week in any year in history, both of which were in the fall when traffic is always heaviest due to crop movement. Loading for the week of May 26 was only 4,510 cars below the total for the week of October 14, 1920, when 1,018,539 cars were loaded, the largest number for any week on record.

New York Bricklayers Still Refuse $11 a Day

According to an announcement made last week by Thomas B. Clarke, president of the old Building Trades Council, New York City, 38 of the 44 crafts included in that organization had accepted the $1 bonus offered by the Building Trades Employers' Association. Of the six crafts still negotiating for an increase the glaziers voted in favor of a strike.

Other developments of the week in the New York district included the refusal of the largest local of the bricklayers' union to accept terms of $1.37½ an hour or $11 a day for the next two years, as proposed by a group of the building industry headed by R. H. Shreve. It has been estimated that the striking bricklayers are holding up $200,000,000 worth of work in the metropolitan district.

Franklin D. Roosevelt, president of the American Construction Council, last week disclaimed any attempt on the part of that organization to bring about a 90-day suspension of construction throughout the country, as charged by certain brick manufacturers and lumber men.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Lumber, Minneapolis, 60,000,000 ft.); time required for delivery of carload lots to city job, example: (hollow tile Atlanta 4 @ 5 days); and stocks on hand in general terms, exampl.: (brick, New York, scarcity.)

	San Francisco	Los Angeles	Denver	Minneapolis	Detroit	Chicago	Cincinnati	New Orleans	Atlanta	New York
Sewer pipe	Stocks in good condition	Slight shortage	Del. 24 hr., local plant	Shipments easier	Ample	Stocks in good condition	Plenty	Sufficient to meet all demands	Del. take 4 @ 5 days	Mill del. slow; 10 days to 2 weeks
Cement	Limited supply	Scarcity	Normal	Readily obtainable	Plenty available	Fairly well supplied	Well supplied	Ample	About 50 cars	Stocks in city small; mill shipments quick
Lime	Fairly well stocked	Plentiful	Sufficient	No great amounts in warehouses	Plenty	Del. in 24 hr.	Enough	Plenty	About 60 cars	Dealers' stocks small; mill del. prompt
Common brick	Reserves in good condition	Supply ample	500,000	No heavy stocks in yards	Enough; no large surplus in yards	Shortage; del. take 2 @ 3 wks.	No scarcity	Enough for present construction	Plenty	Scarcity; strikes in yards
Hollow tile	Stocks in excellent shape	Demand strong; no shortage	Stocks normal	Shipments better	Enough for immediate needs	Del. take 7 @ 10 days	Sufficient	No shortage	Del. take 4 @ 5 days	Recent shipments from plants heaviest on record
Lumber	Heavy shipments continue	Large stocks at harbor	Mill shipments easier	60,000,000 ft. in yards	Moderate stocks on hand	Stocks in good shape. Del. take 30 @ 60 days	Shortage	Pine stocks low	Plenty pine	Del. take 5 @ 6 wk. from mill
Asphalt	Heavy native stocks	Well supplied	About 10 cars	Plenty	Small stocks; quick shipments	Limited supply	.....	None in stock	About 50 cars	Heavy reserves in N. J.
Structural steel	Structurals, fair; rivets, improving	Demand steady. Del. take 2 @ 3 months	Warehouse stocks sufficient	Mill shipments improved	No shortage	Mill shipments heavy	Del. from mill in 6 @ 8 wks.	Enough in warehouses	About 6 cars	Del. take 30 @ 60 days from mill

in warehouses or yards because of the ease in getting prompt shipments from sources. Lumber in Twin City yards normal for season, 60,000 to 75,000 M. ft., estimated. Noticeable showing up in building operations in last several weeks leaves yards well supplied.

Detroit — Construction materials available for all building needs. Dealers increasing stocks, previously depleted. Car shortage anticipated; materials being accumulated to forestall this condition.

Chicago—Little change in conditions of materials stocks during month. Shortage of brick continues; asphalt supply limited; plenty of other materials.

Cincinnati—Scarcity of lumber; other building materials plentiful.

New Orleans—Stocks of yellow pine low; other construction materials on hand ample to meet all demands.

Atlanta—Plenty of brick and lumber. Sewer pipe and hollow tile deliveries take from four to five days. Between forty and fifty cars of cement; fifty and sixty cars of lime; fifty cars of asphalt and from four to six cars of structural steel, on sidings.

New York—Dealers' stocks small because of limited space and usually quick mill deliveries by rail and water. Present scarcity of brick unprecedented. In former years some brick usually remained over from the preceding season, frequently lasting up until early summer. This year no 1922 brick are in sight and the new output has not yet entered the market to an appreciable degree. Sand, gravel and crushed stone situation improved.

Labor Unions Establish Bank in New York City

The Federation Bank, opened a few weeks ago in New York City, is a new type of labor bank. Single unions have organized banks within the past year of two, but so far as is known this is the first one which is a co-operative institution. In the beginning it had 142 unions, representing all the various trades and branches of industry in New York City and it was organized by the central labor body of the city on a co-operative basis. Its directors are not entirely trade unionists. About 60 per cent are of that class, the others being made up of financiers and business men who were individual subscribers in its formation.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 349 to 362, are the following large projects:

Library, Cleveland, O., to Lundoff-Bicknell Co., $4,000,000.

Coagulation basin, Cleveland, O., to Stange-Walsh Construction Co., $1,365,-425.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 349 to 362, are the following:

Hotel, New Orleans, La., for the Grunewald Hotel Co., $3,000,000 to $4,000,000.

High school, Brooklyn, N. Y., for Board of Education, $2,000,000.

Canal, Wichita Falls, Tex., for Wichita Co. Irrigation Dist. No. 1, $1,500,000.

Office building, New York, N. Y., for Fifth Ave. and 46th St. Corporation, $1,000,000.

Decline in Lumber Movement Has Been Checked

Reports received June 7 by the National Lumber Manufacturers Association from the various regional lumber manufacturing associations, indicate that the decline in the lumber movement, which has continued for some time, has been checked. All the reporting mills give shipments as 96 per cent, and orders as 74 per cent of production. Southern pine mills by themselves show similar percentages of 102 and 38 respectively, and the West Coast mills 113 and 96. All but 32 of the mills represented in the compilation have established normal production figures for the week, and with respect to them their actual production was 106 per cent of normal, shipments 107 and orders 82 per cent of the same.

For the first 22 weeks of 1923 and the corresponding period of 1922, the lumber movement by association mills is as follows:

	Production	Shipments	Orders
1923	5,240,206,937	5,685,226,723	5,742,306,525
1922	4,296,022,595	4,405,941,852	4,831,310,012
1923 Increase	944,184,342	1,279,284,871	910,996,513

Business Conditions Surveyed

Production and trade continued in large volume during April, according to the monthly review of credit and business conditions by the Federal Reserve Bank, New York, but there was some slackening of business activity in the latter part of the month and during the early weeks of May, partly on account of seasonal influences. The Federal Reserve Board's index of production in basic industries declined about 1 per cent in April.

Production of lumber, anthracite and mill consumption of copper decreased, while there were increases in the output of pig iron and petroleum. There was a further increase in the value of building contracts awarded in April, but the value of building permits issued in 168 cities was 16 per cent less than the record figures of March. The decrease is said to be due chiefly to a curtailment of new projects in New York, as the aggregate value of permits at other reporting cities showed an increase of 20 per cent. Carloadings continued to be much larger than in the corresponding weeks of previous years, owing chiefly to heavy shipments of manufactured goods. In spite of present heavy traffic the shortage of freight cars has largely disappeared.

Employment at industrial establishments continued to increase during April, although plants in Eastern states reported some reductions in their forces and there was an increase in those states in the number of concerns working part time. Increases in wage rates were announced by many concerns and average weekly earnings of factory workers increased about 1 per cent.

The general index of wholesale prices

of the Bureau of Labor Statistics showed no change between March and April. Prices of building materials, metals, cloths and clothing were higher in April than in March.

In May, as in April, money rates continued to become slightly easier, in accord with the usual seasonal tendencies. Commercial paper sales were somewhat more generally at 5 per cent and in a few cases were 4½ per cent compared with prevailing rates of 5 to 5½ per cent a month ago.

Freight Car Shortage Reduced

Despite the fact that the number of freight cars loaded with revenue freight is now the largest for this time of year in the history of the railroads, shortage in freight cars has virtually disappeared, according to reports filed May 24 by the carriers with the Car Service Division, American Railway Association.

Shortage in freight cars for the country as a whole on May 14 totaled 23,761, which was a decrease of 4,555 since May 7. Compared with the car shortage on Jan. 1, 1923, this is a decrease of nearly 60,000 cars, with a decrease since April 1 of 45,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 3; the next, on June 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.30	$4.50	$3.40	$3.55	$4.20	+$3.95	$4.10	+$4 25
Structural rivets, 100 lb.	4.40	5.00	+4.95	3.75	4.25	+5.40	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	4.25	3.70	3.32½	3.45	3.85	3.65	4.10	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	+44%	—52%	45%	+47%	53-5%	36%	35.2@47.6%	40%	32.76
Cast-iron pipe, 6 in. and over, ton	62.50@63.50	+55.00	63.00	60.20	60.50	69.00	60.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl	2.70@2.80	2.85	2.25	2.20	2.39	2.84	2.71	2.90	2.25
Gravel, ¾ in., cu.yd.	2.25	1.90	2.25	2.00	+1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.95	2.00	+1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.50	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	65.00	42.00	53.00	—58.50	—44.75	+60.00	41.00	+32 00	90.00
Lime, finishing, hydrated, ton	18.20	23.50	22.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.50	1.50	1.50	2.70	1.75	2.80	—10.00
Common brick, delivered, 1,000	23.50	14.00	12.90	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	+.109	.115	.1032	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1573	+.109	.115	.0825	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	1.16	—1.24	1.35	1.37	1.29	1.39	1.24	.86	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	....	....
Common labor, non-union, hour	.....	.30	.30@.50	+ 85	+.55	.35@.50	.50	.50@.62½	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 81½c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.65½). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 10 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Heavy steel rail buying constitutes the principal feature of the current market; car materials, tank and ship plates also in demand at Pittsburgh mills. Production continues at a high rate with increasing improvement in mill shipments. Demand assuming conservative proportions as better deliveries induce buyers to show less concern over forward requirements. The $2.50 base holds firm for structurals, with the maximum on plates at $2.60 per 100 lb. for prompt deliveries. Bars at minimum of $2.40, f.o.b. Pittsburgh.

Some advances in steel structurals reported in Dallas, Denver, San Francisco and Montreal. Cement and brick prices remain fairly firm throughout the country. Lumber prices have changed but little recently. Denver and Seattle, however, report advances in Douglas fir; Minneapolis, a decline in fir and Chicago a drop in yellow pine timbers, during the last two weeks. Linseed oil dropped 2c. per gal. in Atlanta; no other changes in oil reported. Both 40 and 60 per cent gelatin dynamite dropped ½c. per lb. in New York, effective June 6.

Latest changes in the labor situation may be briefly stated as follows: **Seattle**—Journeymen plumbers and steamfitters advanced to $10 per eight hr. day; helpers to $6, effective June 1. **San Francisco**—Carpenters union demands $9 per day as minimum wage, against $8, as at present. **Chicago**—Bricklayers advanced from $1.15 to $1.25 per hr; structural iron wrokers, from $1.05 to $1.25; hoisting engineers receive $1@$1.25; hodcarriers 88½c. and common laborers, 82½c. per hr. according to the new scale effective June 1. Bricklayers and strucural iron workers on closed shop basis. **New York**—Plan proposed to grant bricklayers $11 per day for two and one-half years. Bricklayers demand contract at $12 per day for two years. Employers previously offered agreement of $10 per day for two and one-half years. Thirty-eight of the forty-four crafts belonging to the old Building Trades Council have accepted advances of $1 per day offered by employers. Six crafts are still negotiating for wage advances with only one, the glaziers, voting to strike.